THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 18 AUGUST, 1939 Number 8

THEODORE HAVILAND, FOUNDER

For story, see page 312

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Volume 18 August, 1939 Number 8

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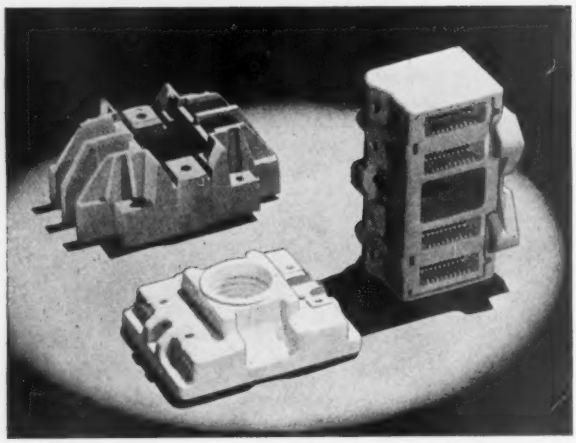

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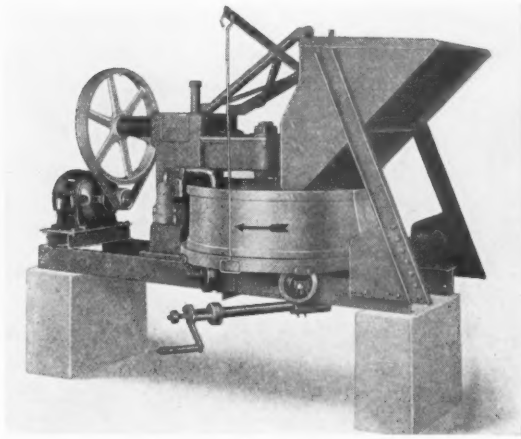

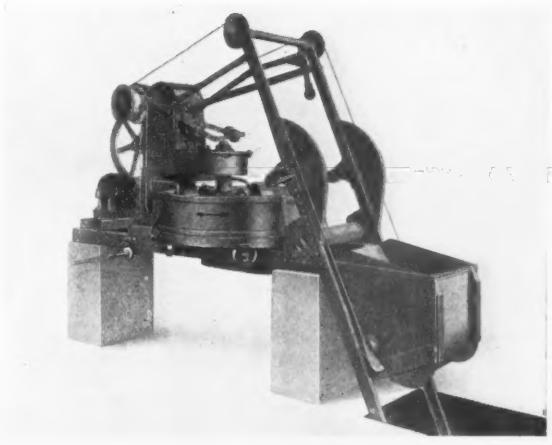

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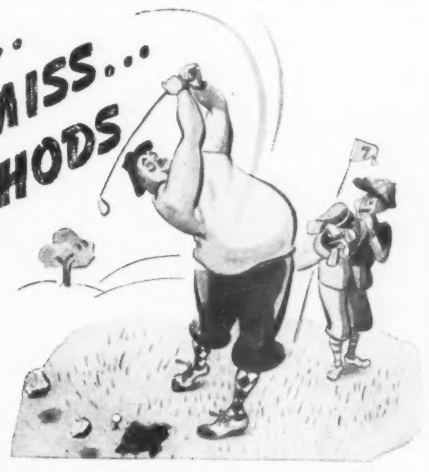

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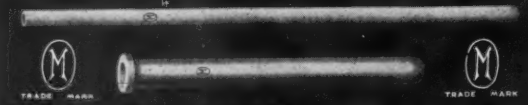

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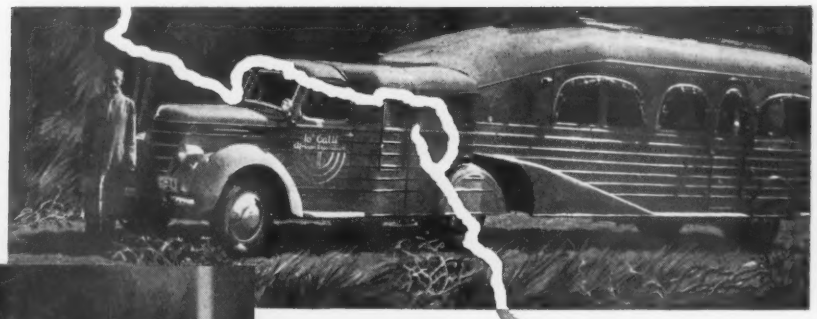

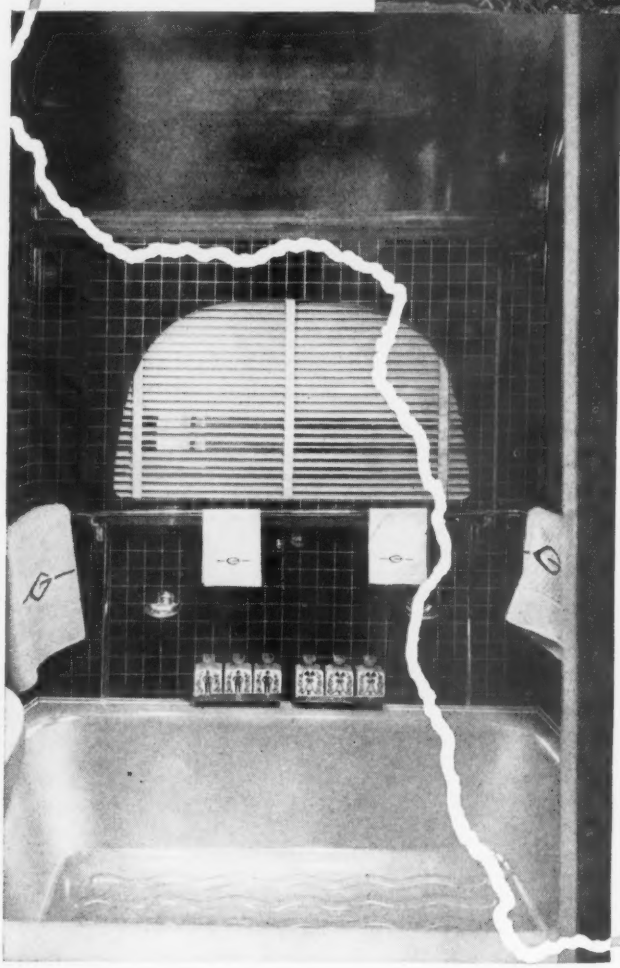

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Metal & Thermit Corp.
Paper Makers Importing Co.
Porcelain Enamel and Mfg. Co.
Spinks, H. C., Clay Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.
United Clay Mines Corp.

Clay (Fire)
Denver Fire Clay Co.
Great Lakes Foundry Sand Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Potters Supply Co.
United Clay Mines Co.

Clay (German Vallendar)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.

The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Clay (Micronized)
Porcelain Enamel and Mfg. Co.

Clay Miners
Great Lakes Foundry Sand Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay (Potters)
Denver Fire Clay Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay (Process Equipment)
Lancaster Iron Works, Inc.
National Engineering Co.

Clay (Sagger)
Georgia Kaolin Co.
Great Lakes Foundry Sand Co.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Potters Supply Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay-Slip (Albany)
Hammill & Gillespie, Inc.
United Clay Mines Corp.

Clay (Wad)
Kentucky Clay Mining Co.
Potters Supply Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay (Wall Tile)
Hammill & Gillespie, Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Cleaners
Pennsylvania Salt Mfg. Co.
Porcelain Enamel and Mfg. Co.

Cleaners, Chemical
Harshaw Chemical Co.
Pennsylvania Salt Mfg. Co.

Clocks (Gauge Board)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.

Cobalt Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Cobalt Sulphate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Colors
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Concrete (Chutes, Grouters)
Ransome Concrete Machinery Co.

Cones
The Edward Orton, Jr., Ceramic Foundation

Conveying Equipment
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.
National Engineering Co.

Copper Oxide
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Corhart
Corhart Refractories Co.

Cornwall Stone (Imported)
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.

Crucibles (Filter, Melting, Ignition)
Carborundum Co.
Denver Fire Clay Co.
Norton Co.
Potters Supply Co.

Crushers (Clay)
Lancaster Iron Works, Inc.

Cryolite (see Kryolith)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
The Vitro Mfg. Co.

Crystolon (Refractory Products)
Norton Co.

Cullet, Washing Plants, Incinerators, Crushers
Frazier-Simplex, Inc.

Cutters (Bar)
Ransome Concrete Machinery Co.

Decorating Supplies
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Disintegrators
Lancaster Iron Works, Inc.
National Engineering Co.

Dryer (Pipe Rack)
Lancaster Iron Works, Inc.

Drying Machinery
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.
Proctor & Schwartz, Inc.

Electrocast Refractories
Corhart Refractories Co.

Enamelers' Borax
Porcelain Enamel and Mfg. Co.

Enameling Equipment (Complete)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Enameling Furnaces
Carborundum Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Lancaster Iron Works, Inc.
Norton Co.

Enameling Iron (Sheet)
American Rolling Mill Co.
Bethlehem Steel Co.

Enameling Muffles
Bethlehem Steel Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Frazier-Simplex, Inc.
Norton Co. (*Alundum*)

Enameling (Practical Service)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Enamel Oxide
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Enamels (Porcelain)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Equipment (Porcelain Enameling)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The DeVilbiss Co.
The Hommel Co., O., Inc.

Exhaust Systems
The DeVilbiss Co.

Feldspar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Filter Fabrics
Metakloth Company

Fire Brick
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Norton Co.

Fire Brick—Process Equipment
Lancaster Iron Works, Inc.

Fire Clay
Denver Fire Clay Co.
Great Lakes Foundry Sand Co.
Spinks, H. C., Clay Co.

Flint
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Great Lakes Foundry Sand Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
Porcelain Enamel and Mfg. Co.

Flint Pebbles
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Floors (Non-Slip)
Norton Co.

Fluorspar
Harshaw Chemical Co.
The Hommel Co., O., Inc.

French Flint
Maxson, Elwyn L.
Paper Makers Importing Co.

Frit
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Frosting Mixtures
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Fuel Oil Systems and Control, Stokers
Bethlehem Steel Co.
Frazier-Simplex, Inc.

Furnaces
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Swindell-Dressler Corp.

Furnaces, Enameling
Swindell-Dressler Corp.

Glass Bending Ovens, Glass Decorating Machines
Frazier-Simplex, Inc.

Glass Equipment
Hartford-Empire Co.
Lancaster Iron Works, Inc.

Glass Melting Tanks and Furnaces
Frazier-Simplex, Inc.

Glass Sand
Great Lakes Foundry Sand Co.

Glass Thickness Gauge
Bausch & Lomb Optical Co.

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.

The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.

Goggles
The Hommel Co., O., Inc.
Willson Products, Inc.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Gold Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.

Granulators
Lancaster Iron Works, Inc.

Grinding Wheels
Carborundum Co. (*Carborundum and Alorite*)
Chicago Vitreous Enamel Product Co.
Norton Co. (*Alundum-Crystolon*)

Hearths
Carborundum Co. (*Carbofrax* heat treating)
Corhart Refractories Co.
Norton Co. (*Crystolon*)

Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.

Hoppers (Floor, Tower)
Ransome Concrete Machinery Co.

Hose (Air and Fluid)
The DeVilbiss Co.

Hydrofluoric Acid
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Iron Chromite
Harshaw Chemical Co.

Iron (Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.

Iron Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Kaolin
Ceramic Color & Chemical Mfg. Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
United Clay Mines Corp.
The Vitro Mfg. Co.

Kilns, China (Decorating)
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Swindell-Dressler Corp.

Kilns- (Electric, Circular, Tunnel)
Swindell-Dressler Corp.

Kiln Furniture (Silicon Carbide, Semi-Silicon Carbide) (Refractory)
Louthan Mfg. Co.

Kyanite
Celo Mines, Inc.

Kryolith (see Cryolite)
Pennsylvania Salt Mfg. Co.

Laboratory Ware
Norton Co.

Lehr Tile (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.

Lehrs
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

Lehrs (Electric or Fuel Heated)
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

Lehr Loaders
Frazier-Simplex, Inc.

Linings (Furnace Refractory, Block Refractory Plate, Brick, and Tile)
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Norton Co.
The Vitro Mfg. Co.

Lithium Carbonate
Drakenfeld, B. F., & Co.

Loaders (Bucket)
National Engineering Co.

Magnesia (Fused)
Norton Co.

Magnesia (Sintered, Calcined)
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.

Magnesite
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Magnesite Calcined
The Hommel Co., O., Inc.

Magnesium Carbonate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Manganese
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Manganese Dioxide
Drakenfeld, B. F., & Co.

Manganese (Oxide)
Ceramic Color & Chemical Mfg. Co.
Corhart Refractories Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Masks (Breathing)
The DeVilbiss Co.
Drakenfeld, B. F., & Co.
Willson Products, Inc.

Metals (Porcelain Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.

Micronized Products
Porcelain Enamel and Mfg. Co.

Microscopes (Polarizing)
Bausch & Lomb Optical Co.

Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Mixers
National Engineering Co.
Ransome Concrete Machinery Co.

Mixers (Batch)
Lancaster Iron Works, Inc.
National Engineering Co.

Mixers (Concrete, Paving, Road Paving, Plaster, Asphalt, Truck, Mortar, Bituminous)
Lancaster Iron Works, Inc.
Ransome Concrete Machinery Co.

Mixers (Laboratory)
Lancaster Iron Works, Inc.
National Engineering Co.

Mold Sanders
Lancaster Iron Works, Inc.

Muffles (Furnace)
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Frazier-Simplex, Inc.
Norton Co.

Mullers (Batch)
Lancaster Iron Works, Inc.
National Engineering Co.

Muriatic Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Needle Antimony
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Nepheline Syenite
Great Lakes Foundry Sand Co.

Nickel Salts
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Nitrates (Cobalt, Sodium)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Nitre
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Norbide (Norton Boron Carbide)
Norton Co.

Olivine
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Opacifiers
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Overglaze Colors
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Oxides
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Palladium Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.

Pins
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Louthan Mfg. Co.
Potters Supply Co.

Pins (Tile Setter)
Louthan Mfg. Co.

Placers (Concrete Pneumatic)
Ransome Concrete Machinery Co.

Placing Sand
Great Lakes Foundry Sand Co.
United Clay Mines Co.

Platinum Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.

Polariscopes
Bausch & Lomb Optical Co.
Frazier-Simplex, Inc.

Porcelain Enameling Service (Practical)
American Rolling Mill Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Potters Wheels
Denver Fire Clay Co.

Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Solvay Sales Corp.
The Vitro Mfg. Co.

Producer Glass Plants
Frazier-Simplex, Inc.

Pug Mills
Lancaster Iron Works, Inc.

Pyrites (Natural Iron Sulphide)

The Hommel Co., O., Inc.

Pyrometer Tubes
Carborundum Co.
Montgomery Porcelain Products Co.

Pyrometer Tubes (Refractory and Hard Porcelain)
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

Pyrometers (Optical, Radiation, Surface, Immersion, Needle)
Pyrometer Instrument Co.

Pyrometric Cones
The Edward Orton, Jr., Ceramic Foundation

Racks, Firing (Refractory)
Louthan Mfg. Co.

Raw Material Handling Equipment
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.

Refractometers
Bausch & Lomb Optical Co.

Refractories
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Louthan Mfg. Co.
Norton Co.

Refractory Materials
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Louthan Mfg. Co.
Norton Co.
Titanium Alloy & Mfg. Co.

Respirators
Chicago Vitreous Enamel Product Co.
The DeVilbiss Co.
Drakenfeld, B. F., & Co.
The Hommel Co., O., Inc.
Willson Products, Inc.

Rutile
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal and Thermit Corp.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Saggers
Carborundum Co.
Norton Co.
Potters Supply Co.

Salt Cake
American Potash & Chemical Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Sandblast Helmets
Willson Products, Inc.

Sandblast Sand
Great Lakes Foundry Sand Co.

Sand Grinder and Sifters
Lancaster Iron Works, Inc.

Saponin
The Hommel Co., O., Inc.

Screening and Magnetic Separators
National Engineering Co.

Selenite of Sodium
Drakenfeld, B. F., & Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Selenium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Setters (Tableware)
Louthan Mfg. Co.

Sheaves (Tower)
Ransome Concrete Machinery Co.

Sheets (Enameling Iron)
American Rolling Mill Co.
Bethlehem Steel Co.

Silica (Fused)
The Hommel Co., O., Inc.

Silicate of Soda
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
The Hommel Co., O., Inc.
Harshaw Chemical Co.

Silicon Carbide
Carborundum Co.
Norton Co.

Silicon Carbide Firesand
Carborundum Co.

Sillimanite Refractories
Denver Fire Clay Co.

Slabs (Furnace)
Carborundum Co.
Norton Co.

Soda Ash
American Potash and Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Sodium Fluoride
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Sodium Metasilicate
Harshaw Chemical Co.

Sodium Nitrite
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Sodium Silica Fluoride
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Sodium Uranate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Soot Blowers
Frazier-Simplex, Inc.

Special Machines
Frazier-Simplex, Inc.

Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Spray Booths
The DeVilbiss Co.
The Hommel Co., O., Inc.

Spraying Equipment
The DeVilbiss Co.
The Hommel Co., O., Inc.

Spurs
Louthan Mfg. Co.
Potters Supply Co.

Stacks
Lancaster Iron Works, Inc.

Steel Plate Construction
Bethlehem Steel Co.
Lancaster Iron Works, Inc.

Stilts
The Hommel Co., O., Inc.
Louthan Mfg. Co.
Potters Supply Co.

Sulfuric Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Talc
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Tanks
Frazier-Simplex, Inc.

Tank Blocks
Corhart Refractories Co.

Tanks (Pickle)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.

Tanks for Raw Material Steel or Concrete
Bethlehem Steel Co.
Lancaster Iron Works, Inc.

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Norton Co.

Tile (Muffle)
Carborundum Co.
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Tile Setter Pins
Louthan Mfg. Co.

Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Norton Co.

Tile (Wall)
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Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Towers (Concrete, Concrete Elevating, Steel Elevating)
Ransome Concrete Machinery Co.

Tri Sodium Phosphate
Harshaw Chemical Co.

Trucks
Lancaster Iron Works, Inc.

Tubes (Insulating)
Carborundum Co.
Louthan Mfg. Co.
McDanel Refractory Porcelain Co.
Norton Co.

Tubes (Pyrometer)
Carborundum Co.
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

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Harshaw Chemical Co.
The Hommel Co., O., Inc.

Uranium Oxide (Yellow-Orange-Black)
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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

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Frazier-Simplex, Inc.

Wet Enamel
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

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Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

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Lancaster Iron Works, Inc.

Zinc Oxide
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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Zircon
The Hommel Co., O., Inc.

Zirconia
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
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PAPERS

A BACKGROUND FOR CERAMICS*

By Lawrence E. Barringer

This Is the Seventh Annual Edward Orton, Jr., Memorial Lecture.

The progress in industrial ceramic operations in the United States has been extremely rapid since the turn of the century, and today this country probably leads all others in efficient quantity production of many ceramic products, such as vitreous enameled ware, sanitary porcelain, and hotel chinaware.

It is within only a relatively short time, however, that interest has been aroused in the nonindustrial phases of ceramics, as in the fields of art, decoration, and education. In these latter fields, there is a wealth of unique and interesting background material which will undoubtedly still further attract and hold the interest of those who are acquiring but casual acquaintance with this grand old art.

Ceramics, chiefly in the form of pottery-making, is now offered in many public-school and college courses, Y.W.C.A. classes, art schools, trade schools, and other educational organizations, including even WPA Federal Art projects, schools for the blind, and as a project in occupational therapy.

An informal survey in the public schools of the State of New York in 1936 revealed the fact that ceramics was being taught in forty schools located in thirty cities. This instruction varied from merely incidental instruction of a few students in "interest groups" with the production of a few shapes of dextrine-hardened, unfired clay to major instruction covering all branches of clayworking in well-equipped shops, the courses lasting a year or more, involving hundreds of pupils, and resulting in the production of thousands of pieces of which many were salable.

If the conservative average is assumed to be thirty ceramic pupils in each of these schools, there are then twelve hundred public-school pupils in New York State annually receiving instruction in ceramics, which is understood to mean "the art of making things of baked clay, as pottery, tile, etc." There are probably eight to ten times this number of public-school pupils receiving ceramic instruction throughout the country or, conservatively, ten to twelve thousand.

Within the short space of five years, about fifty to sixty thousand youngsters in our public schools receive some sort of instruction in ceramics, in addition to adults in public-school evening classes and other adult educational groups, and they are thus brought into brief contact with the oldest, most natural, broadest, and most generally useful of all arts.

There are also thousands of amateur and professional designer-craftsmen producing personally designed and fabricated ceramic ware on a small scale, either as a hobby or for private sales.

Such far-flung interest in nonindustrial phases of ceramics is significant.

The wide-spread teaching of ceramics undoubtedly indicates its desirability both as to student interest and educational values. In the opinion of the speaker, this evident belief in the value of ceramics as an educational subject is thoroughly well founded and fully justified.

Man is by nature a potter in that everyone likes the "feel" of soft plastic clay or of clay mixtures. To test this, hand any casual visitor a small lump of soft clay. Is it held listlessly or immediately dropped? No! The fingers invariably start fashioning the clay into some simple form, perhaps only a ball or "pill," but more often into a little saucer or dish-shaped piece. The piece of clay is usually retained and worked into various simple shapes before he departs.

This universal and immediate liking for the feel of clay has proved to be of great practical value in claiming the interest and attention even of the most difficult "problem" pupils.

Mabel C. Brady of the Haaren High School of New York City, in speaking before the Art Division of this Society at Baltimore in October, 1936, said, "It (ceramics) has served not only as a means of creative expression and development of art appreciation in the average student but has been of great value in socializing many problem students otherwise antagonistic

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 16, 1939 (The Edward Orton, Jr., Memorial Address). Received March 31, 1939.

toward any other form of instruction or guidance." The "problem pupil" is happily in the minority, however, and the interest developed by ceramics finds equal, if not greater, values in normal and even in advanced groups.

Aside from immediate appeal to the fingers and to the desire to "make something," the clayworking branch of ceramics has been found to possess definite and important educational values.

Raymond P. Ensign, Executive Director of the National Association for Art Education, in communicating his views upon ceramic instruction to the Art Division of this Society at Baltimore in October, 1936, made these comments:

> Some years ago, millions of dollars were spent in the school systems of America in equipping shops with heavy, fixed, and costly machinery for the purpose of teaching woodworking, tinsmithing, and other trade processes. I sometimes question the real educational value to an adolescent youth of his part in throwing a switch or moving a lever back and forth for the sake of seeing a machine turn out a galvanized iron cornice. Such a cornice is a "fake" to begin with, imitating in its form traditional wood or stone construction. Secondly, only a small proportion of the boys would ever meet sheet-iron cornices face to face in after life. Thirdly, how much did the average student's young mind and soul unfold while the machine's inner works labored to give forth the iron molding?
>
> I can not help contrasting such a situation to the stimulating one which confronts a young potter before his wheel. Here his creative imagination is challenged and given scope for productive experimentation. Here his mind, eye, and hand learn coördination and control.
>
> Here he learns about the functioning of line, form, and later of color in the achievement of a product basically sound and aesthetically satisfying. And here his experience and his product may have large implications in relation to his afterlife in home, business, and community.
>
> We hear much in educational circles these days of "integration." I can think of no school activity offering a more fruitful field for the integration of other *subjects* in secondary schools (and hence fruitful in the integration of the expanding *individual*) than ceramics. How aptly his research into the development of pottery ties up with his survey of history. His concern with materials and costs may well enliven his study of economics and mathematics. His investigations into the raw materials of ceramics and their sources may well quicken his interest in the geography of world commerce. His study of clays and glazes may make rich his laboratory experiences both in chemistry and physics.

A subject of such immediate appeal and high educational value offers an unusual opportunity as an exploratory means of ascertaining other pupil interests and of expanding the cultural values of education practically in all directions but, unfortunately, it is only the occasional teacher who possesses the broad knowledge of the ceramic arts to present its highly interesting and stimulating background to classes in ceramics.

Orton's pioneer work at the turn of the century not only created an interest in the technical or engineering branch of ceramics, but it led to the training of chemists and engineers qualified to devise and execute the most effective technique for the industrial production of all types of ceramic ware. In other words, Orton provided a much-needed background for the future commercial production of ceramic products by pointing out what had been lacking in the technical literature and training of his day, how the situation could be remedied, and how industry could profit from technically trained men. His lifetime was spent in this important work, and today many of our leading colleges and universities offer complete four-year courses in ceramic engineering corresponding with those in other lines of engineering, such as civil, mechanical, mining, and chemical.

Orton made no attempt, however, to include in his work other than the engineering and manufacturing phases of the great ceramic industry.

In view of the widespread and increasing interest in ceramics, of the unusual cultural values inherent in this subject, and of the greater pleasure and zest that a broader knowledge of the art will provide not only for students but for designer-craftsmen, connoisseurs, collectors, and even the discriminating user of ceramic ware as well, it is highly desirable to impart more information concerning this ancient and enticing art to the thousands brought in brief contact with it than has been done heretofore—in other words, to furnish a better background for the ceramic arts as distinguished from ceramic industrial production technique.

In some schools and social service classes, a commendable collateral program is used with ceramic classes; in one senior high school in the State of New York actual pottery-making is supplemented by a survey of the history of ceramics, studies of the influence of climate, temperament, and religion upon the potter's art, and by trips to museums and to large stores to develop appreciation of ancient and modern work and discernment between the excellent and mediocre. Such cases, however, are rare, and the usual class in clayworking learns but little more than the work laid out for it, although it is nearly always intensely interested in such work.

What is to be said of ceramics to all those who are passing by? What is represented by the window dressing of "pottery classes?"

I

> "The world is so full of a number of things
> I am sure we should all be as happy as kings."
>
> —*Robert Louis Stevenson*

Even before a historical development of the subject, let us make clear that the term "ceramics" is no longer confined to the very narrow meaning of the original Greek word from which it was derived, but is today generally accepted by those engaged or interested in ceramics as "comprising all products fashioned from silicates or oxides and rendered durable in form and composition by a heat treatment applied at some stage of the process."

Ceramics is thus the art of producing from natural inorganic materials with the aid of heat a bewildering number and variety of articles with an extremely wide range of usefulness and beauty.

The tabulation of ceramic products (Table I) has been prepared to illustrate the wide scope of the field, this form of presentation having been suggested by a somewhat similar tabulation published in Ceramic Catalogs in 1934. (For Table I, see pp. 278-79.)

It is obvious that not more than a very general classification can be presented with a fair degree of completeness and clarity. Anyone interested, however, will be able to fill in specific items in great number under most of the classified groups.

There is something to be told, therefore, about the variety of ceramic products and of their great usefulness to the human race.

II

"And while he plied his magic art—
For it was magical to me—
I stood in silence and apart,
And wondered more and more to see
That shapeless, lifeless mass of clay
Rise up to meet the master's hand,
And now contract and now expand,
And even his slightest touch obey."
—"Keramos," *Henry Wadsworth Longfellow*

While indeed fascinating and indispensable as a "first call to ceramics," the formation of articles from soft clay upon the potter's wheel does not constitute the entire art, and there are other branches which may prove of equal interest as to their susceptibility to artistic treatment, technique of production, and variety and beauty of the product.

Tile, for instance, require an entirely different method of production and are useful in altogether different ways from vases, cups, bowls, plates, or other articles most conveniently formed upon the potter's wheel.

Tile have a rich, historical background, are highly useful in a variety of decorative applications, can readily be produced upon a small scale, and are susceptible to the whole range of decorative ceramic treatment.

While in Florida recently, the speaker noted particularly the extensive and effective use of decorative tile, most of which were of Spanish origin but with some representation of American tile. In the cloistered courts and patios of the Boca Raton Club at Boca Raton, enameled tile are used effectively for walks, garden edgings, benches, fountain basins and stands, step-risers, and decorative panels in gateway columns. At the John L. Ringling Hotel in Sarasota, one observes immediately the tiled wainscotings, borders, stair-risers, and panels. In the homes at Mountain Lake, one is impressed with the effective use of tile, often in unique ways, such as for baseboards and for lining sideboard niches or recesses. Tile are also used in many of these beautiful homes for fireplace facings and hearths, wainscotings, stair-risers, borders, inserts or panels in cement walls, table tops, and of course in the patios and gardens for many purposes. Upon speaking admiringly of a fireplace faced with large Spanish tile, the speaker was informed by the owner that only one tile was original, the others being copies made by an American woman in her ceramic studio-shop. The copies could not be distinguished from the original, except perhaps by close study upon the part of an expert. At Mountain Lake, richly colored faience tile made by H. Dulles Allen are used effectively for the grilles of the Bok Tower.

Tile may carry a design either cut in (incised) or built up, they may be plain, enameled, or glazed, they may carry underglaze or overglaze decoration, and they may be large or small and made in a variety of shapes other than square, such as diamond-shaped, octagonal, etc. Large, blue enameled, diamond-shaped tile are used efectively for the bathroom floors of the Boca Raton Club.

In the speaker's opinion, the manufacturers of ornamental tile are too modest in promoting the possibilities of their product. "Pottery teachers" and designer-craftsmen likewise apparently are not giving the attention deserved by this outstanding ceramic product which can be made in a small way even more readily than products of the potter's wheel and for which the uses are probably more varied and permanent.

Terra cotta, or *ceramic sculpture*, in some ways not as adaptable to classroom or studio treatment as pottery and tile, has important advantages over other branches of ceramic art.

Clay modeling requires nothing more than the hands and a few simple hand tools. It is the simplest and most fundamental form of ceramic art, or of any art, because it involves no other technique than the eyes, hands, and judgment of the worker. There is nothing else to manipulate, such as wheels, molds, or cutters.

In addition to affording a means of self-expression in form and color, as in pottery and tile, clay sculpture also provides the opportunity of molding the human figure and animals. It thus enters a field in which expression can be given to ideas and to the emotions, such as music, devotion, sorrow, gaiety, and sympathy, or to such types of people as an old man, dancing girl, wrestler, and hunter, or to difference in races as Chinese, Indian, and African. In animals, action, cunning, ferocity, and gentleness may be expressed.

As a matter of fact, clay modeling or ceramic sculpture has formed the principal part of the work in the Haaren High School of New York where Mrs. Brady has so successfully demonstrated the value of ceramics as an educational project.

Ceramic sculpture is quite adaptable to studio treatment as manifested by many artists from very early times.

The figures for the fountain in the grounds of the Roosevelt Hospital, New Brunswick, New Jersey, designed and executed by Waylande Gregory, and the massive terra-cotta statue of Christ, placed 9000 feet high in the mountains overlooking Santa Maria del Monte, Colorado, designed by the T. H. Buell Company and executed by the Denver Terra Cotta Company of Denver, are but two examples of creative art and individual production in terra cotta.

The principles involved in terra-cotta production are identical with those of clay modeling learned in the classroom.

Vitreous enameling of metallic surfaces is one of the oldest branches of the ceramic art, enameled objects having been found among the oldest of Egyptian relics. Contemporary craftsmen of many European countries, especially France, Germany, and England, include this medium in the practice of modern decorative art. It is well adapted to school and studio production and to the work of professional designer-craftsmen.

TABLE I
CLASSIFICATION OF CERAMIC PRODUCTS

Ware	Construction material	Home furnishings	Industrial equipment	Public utility products	Miscellaneous
Pottery (porcelain, stoneware, china, earthenware, etc.)	Bathroom equipment (bathtubs, wash bowls, closets, fixtures) Laundry tubs Electrical wiring devices Doorknobs Drinking fountains	Cookingware (baking dishes, casseroles, etc.) Kitchenware (other than for cooking—crocks, bowls, etc.) Tableware Art and novelty ware (vases, jars, boxes, bookends, statuettes, figures, trays, jardinieres, lamp bases, tea sets, etc.)	Acidproof stoneware for manufacture of chemicals Chemical laboratory porcelain Porcelain parts for textile machinery Linings and balls for grinding mills Spark plugs Radio equipment	Insulators for high-tension transmission Street-lighting fixtures Telephone and telegraph insulators	Garden pottery Dental porcelain (dentures, crowns, fillings)
Tile (plain, mosaic, faience, etc.)	Floor tile Wall tile Roofing tile Fireplace tile (facings and hearths) Store fronts Vaulted ceilings Bath- and sunroom tile Stair-treads and risers Wainscotings Grilles Baseboards Built-in medallions	Framed medallions Table tops Hot-plate stands Bookends	Linings for coal bunkers, acid tanks, ice boxes Dairy floors Air-conditioning units Grills for electric heaters Switch plates	Swimming pools Public baths School corridors and wainscotings Street and traffic signs House numbers Nonslip stairs and ramps Subway and tunnel linings	Garden and cloister adornments: benches, edgers, walks, fountains, pools Bell-tower grilles
Terra cotta	Exterior building walls and decoration Interior walls and decoration Statues Fountains	Figures Bookends Ornaments Doorstops Lamp bases			Garden pottery (urns, sundials, etc.) Memorials and commemorative monuments
Brick and other heavy clay products	Walls Enameled brick facings Salt-glazed brick Structural hollow tile Chimney tops Copings	Fireplace fronts	Acid-proof brick	Street and road paving Wire and cable conduits Sewer pipe	Farm drain tile, silo tile, septic tanks
Glass	Building block Windows Skylights Outdoor flooring Bathroom fixtures Doorknobs Stained-glass windows	Cookingware Kitchenware Tableware Mirrors Table tops Art and novelty ware	Automobile windshields Chemical glassware Insulators Bottles Battery jars Lamp bulbs Radio and X-ray tubes	Street-lighting globes and fixtures Road traffic signals Railroad signals	Glass eyes Eyeglasses Optical glass Fibrous glass products

CLASSIFICATION OF CERAMIC PRODUCTS (*continued*)

Ware	Construction material	Home furnishings	Industrial equipment	Public utility products	Miscellaneous
Vitreous enamels	Exterior wall facings Roofing tile Bathroom and kitchen equipment Interior panels Fireplace facings Mural decoration	Cookingware Kitchenware Tableware Art ornaments and novelties Mosaics Panels Plaques	Finish for refrigerators, stoves, washing - machines, scales, etc. Store fixtures Linings for tanks and processing units	Street signs and traffic semaphores Street-lighting reflectors Advertising signs	Jewelry Illuminated signs Signs and numbers for all purposes
Refractories (firebrick, etc.)	Flue linings Fireplaces Fire walls Incinerators	Domestic stove and furnace parts	Boiler linings Furnace linings Kilns; glass pots; crucibles; electric furnace insulation; arc-resistant insulation; pyrometer accessories		Crematories

A wealth of color and design is available to the worker in vitreous enamels whether the objective is a bit of jewelry or an extensive mural decoration.

H. Edward Winter of Cleveland, Ohio, who has been successful in designing and executing vitreous enameled murals and in using this subject as an educational project, believes that enameling offers an unusually interesting and stimulating subject for inclusion in the artwork of any educational system. Speaking before the Art Division of this Society at Baltimore in October, 1936, he stated:

> In designing with the enamel, new techniques prove that to enamel a plate or an object successfully with various colors one does not need to employ the cloisonné wires or champlevé cell techniques, as was once believed necessary to keep the enamels from running into one another. An intricate design pattern may be executed in enamel with the graffito technique, a scratching away process which produces interesting effects with the ease of any graphic medium. This technique, more than any other, will allow students free reign with their spontaneous creative ideas. They may draw in enamel as they would on paper with pencil or charcoal. Designs, both realistic and abstract, portrait and caricature drawings, may be done with this medium, and when the work has been finished by firing, a permanent object of beauty is the result.

Visitors to the New York World's Fair this year may see a hundred or more vitreous enameled murals designed and executed by J. Scott Williams, Daniel Boza, Russell B. Aitken, and other artists. Among these is the largest mural ever produced with vitreous enamels (28 feet high by 72 feet long).

Glassmaking, in general, is not so readily adaptable to laboratory or studio production because of its more difficult technique and the special skill required before the worker can readily execute his original designs.

Upon the other hand, glass offers an unusually excellent medium for individual expression in design, color, and decoration. Seemingly more individual artists and craftsmen participating in the production of the leading glassmaking establishments of the world are known to the lovers of fine glass than the artists in other ceramic fields are to their buying public. In fact, it has been this individuality in conception and execution that has been largely responsible for the fame of such glassware as Murano, Lobmeyr, Lalique, Orrefors, Leerdam, Steuben, and others.

Glass may be shaped not only by molding and blowing into forms practically without limit, but it may be decorated in many ways of which some are unique. The body of the glass itself may be colored throughout or made with colored laminations or surface coloring applied in the forms of enamels. Various decorative designs may be applied to the surface by cutting, tool-engraving, acid-etching, sandblasting, stippling, and other methods. The effect of transmitted, reflected, or refracted light upon decorated glass offers an entirely unique field of possibilities, especially in securing delicate and changeable color effects not possible with opaque ceramic ware.

The field of glass, therefore, should prove to be of great attraction to all interested in ceramic activities and particularly to prospective designer-craftsmen.

The designing and production of stained-glass windows, panels, and medallions is not only an attractive field for craftsmen but has been used successfully in educational projects, as in the Connick Studios and in Y.W.C.A. and Y.M.C.A. classes in Boston. Although the field for stained glass is relatively not large, there is no branch of ceramic art that requires a greater degree of originality and skill. No two stained glass windows are alike and the designer-craftsman is always confronted with new problems and fresh interests. Designs must harmonize with architectural schemes, ideas must be expressed by skillful symbolism, and the artist must know something of the effect of transmitted light upon color and of colors upon light.

This is an activity which can not be as completely spoiled by industrial production as have some of the other branches of ceramic art, such as Chinese porcelains. The originator of a beautiful stained glass window, furthermore, is far more assured of his work

remaining to please future generations than are the creators of more portable ceramic products.

These remarks are sufficient to indicate that there is something to be said to the prospective worker or student in ceramics as to the comparative possibilities of different branches of the art from the standpoint of individual design and craftsmanship.

Not all ceramic products are susceptible of artistic treatment—one would not expect to do much with a refractory product—but most of them will be found well worth consideration.

III

It is evident that the creation of some types of ceramic products is not dependent upon the inherent plasticity of clays. Glazed Egyptian tile from a palace of Rameses II at Kantir contain as high as 93% of silica, indicating the use of a high percentage of nonplastic ingredients and fabrication by some other means than plastic molding.

The plasticity or workability of other ceramic products is achieved by heat, as in glass and enamels.

The ceramic arts, therefore, need not be considered as comprising plastic materials only.

Inasmuch as the producers of articles made from modern synthetic resins have appropriated the term "plastics" to indicate their field (although using normally nonplastic materials), it is more necessary today to understand that the ceramic arts are not confined to the manipulation of plastic clays nor are many so-called plastics products of a ceramic nature.

IV

"I would rather be able to appreciate things I can not have than to have things I am not able to appreciate."
—*Elbert Hubbard*

A desire for the ability to distinguish the good from the mediocre in ceramic ware may be stimulated by reference to outstanding products, supplemented by visits to museums, art galleries, and important private collections. Reliably illustrated books and catalogues may be used to advantage, but actual specimens are preferable.

An interest in ceramics generally will be sharpened and broadened by a background knowledge of the ceramic ware with which everyone is surrounded but which few really observe.

How many guests at a formal dinner know whether the chinaware placed upon the table is porcelain or bone china, whether it is Copenhagen, Wedgwood, Lenox, or of some other celebrated factory? Are those amusing colored glass table decorations Murano? Those crystal-clear water and wine glasses may be Steuben or Orrefors. Should one be careful of the translucent, shell-like ash trays (which may be Royal Worcester) or are they something "from the Five and Ten" for the careless cigarette smoker?

Perhaps some of the ladies may discern these things, but to most of the men they are probably "just the dishes and ornaments."

What about the gleaming tile of interesting design which form the facing and hearth of the fireplace in the living room? Are they Dutch or Spanish, faience or pressed?

It is inadvisable to become so curious about the tableware of a hostess as to turn the plates over to see whether or not a judgment is correct as to the type and origin, but an interest in these things set out for a guest's pleasure will always be repaid.

Charles Dickens records one occasion upon which he took special note of the chinaware and glassware set before him. The following opening paragraphs are quoted from his article, "A Plated Article," published in *Household Words* in 1852:

Putting up for the night in one of the chiefest towns of Staffordshire, I find it to be by no means a lively town.

I have paced the streets and stared at the houses and am come back to the blank bow window of the Dodo; and the town clocks strike seven. I have my dinner and the waiter clears the table, leaves me by the fire with my pint decanter, and a little thin funnel-shaped wine-glass and a plate of pale biscuits—in themselves engendering desperation.

No book, no newspaper!

What am I to do? To burn the biscuits will be but a fleeting joy; still, it is a temporary relief, and here they go on the fire! Shall I break the plate? First, let me look at the back and see who made it: Spode.

Spode! Stop a moment. Was it yesterday I visited the Spode Works and saw them making plates? In the confusion of travelling about, it might be yesterday or it might be yesterday month; but I think it was yesterday. I appeal to the plate. The plate says, decidedly, yesterday.

Then follows a delightfully fanciful account by the plate itself of the method of its production at the famous Spode factory in the smoky but picturesque town of Stoke.

Charles Lamb, in beginning his charming bit of reminiscence, "Old China," writes:

I have an almost feminine partiality for old china. . . . . I can call to mind the first play and the first exhibition that I was taken to; but I am not conscious of a time when china jars and saucers were introduced into my imagination.

Watching a potter at his wheel inspired Longfellow to the flight of fancy of "Keramos" in which is indicated his broad knowledge of famous potters and their ware. It is interesting to note in his poem that the potter's art is not restricted to "pots" but ranges from "bracelets with blue enamelled links" of the Egyptians to "the fragile forms of clay" created by Lucca della Robbia and "made perfect by the furnace heat."

Porcelain was included among the gifts presented to Saladin by Richard III during the Crusades, as recounted in "The Talisman" of Sir Walter Scott. It was considered one of the choicest gifts that could be made as it may well be today if selected with discrimination.

So one may continue and quote from those who have recorded their interest in ceramic objects about them.

Once the interest in present-day ceramics has been aroused, there will naturally follow an interest in historic ware. Such an interest will lead one to exhibits and to references and thus form an added objective in traveling which will certainly increase the pleasure thereof.

It is a tiresome business when traveling to "do" museums and galleries largely for the sake of being able

to tell of doing so, but the ceramist, be he student, craftsman, collector, or connoisseur will do well to weave a thread of ceramic objectives through his travel plans.

Certainly anyone in New York City will be thrilled with the old Chinese porcelains in the Metropolitan Museum of Art and impressed with the Hispano-Moresque pottery in the museum of The Hispanic Society of America. While in New York, with a day to spare, also run down to Trenton and see the show-room display of that outstanding American china—Lenox. It is a product in which the American ceramist should take great pride.

When in London be sure to see the wonderful collections of Chinese porcelains and Italian majolica in the Victoria and Albert Museum as well as the Chinese porcelains in the British Museum.

Some bright, sunshiny morning in Paris walk over to Saint Chappelle about eleven o'clock and see its lovely stained-glass windows at their best and then go out to Chartres in the afternoon and there drink in the beauties of the stained glass enhanced by the rays of the afternoon sun.

Anyone visiting Germany who fails to visit the Near East Section of the State Museum in Berlin and the section of the Processional Street of Nebuchadnezzar II, transported from ancient Babylon and reset as upon its original site, has certainly missed a ceramic treat. Its walls and gateways of blue enameled brick are decorated above and below with colored rosettes and with alternate reliefs of bulls and dragons in yellow and white enamel, a most striking and beautiful piece of work using enameled brick with relief ornamentation.

This is not only an outstanding work of ceramic art but it stirs the imagination with respect to the antiquity of an art already highly developed five or six centuries before Christ.

While in this Berlin State Museum also see its collection of Greek vases—an unusually good exhibit.

From Dresden, it is but a short motor trip to Meissen, where have been preserved specimens of Dresden porcelain from the polished redware of Böttger, made just before his discovery of materials with which to duplicate the wonderful white translucent porcelain that the Chinese had been making approximately eight hundred years before his time. Dresden porcelain has held its place among the world's best ware.

A sojourn in Florence provides the opportunity to visit the unusual private museum of Societa Ceramica Richard-Ginori at nearby Doccia—a condensed history of the development of modern Italian ceramics.

In this field of interest, items might be added indefinitely.

V

Now, if one has established a background of interest in things ceramic, he is likely to explore the greatest and most interesting field of all, the origin and historical development of the ceramic arts, veritably the history of the human race, for much of our knowledge concerning prehistoric peoples has been gotten through the inscriptions and various subjects depicted upon tablets, brick, tile, vases, and other forms of fired clay.

As Goldman stated in a paper presented before this Society[1] in 1934,

> For the civilization of classical Greece, pottery is but one and a minor source of evidence, but as soon as we try to deal with the periods preceding the time of great buildings and of written records, pottery is always of major importance and often through its stratified layers in the earth our only means of defining successive cultural phases. "By their works shall ye know them" has a very special and a very literal meaning for the prehistorian.

E. A. Speiser, Professor of Oriental Studies in the Graduate School at the University of Pennsylvania, was quoted as follows in the Paris edition of the *New York Herald-Tribune* of April 15, 1937:

> Because we have no trace of languages further back than 3000 B.C., we knew practically nothing about this people. To our astonishment, we found they were the builders of remarkable modern architecture. Magnificent temples, built in clay, decorated in red brick, were unearthed. The style, believe it or not, was "Renaissance." And, mind you, people were thought incapable of building anything in those times.

Dr. Speiser further states in a recent personal communication,

> The most probable date for the beginnings of pottery is the sixth millennium B.C. My own excavations at Tepe Gawra have helped in carrying back our knowledge of the earliest settlements in Mesopotamia to about 5000 B.C. This is the absolute bottom of that part of the world (that is, in central Mesopotamia; southern Mesopotamia is approximately one thousand years later). But even Neolithic occupations known to us were not of local origin. They had been imported from elsewhere. The knowledge of pottery had come in with that importation. Its source remains to be determined. But internal indications make it extremely likely that those elusive beginnings were not many centuries older.
>
> While the most beautiful pottery of antiquity is that from earliest Susa (in southwestern Persia, about 3000 B.C.), the most perfect technically belongs to the so-called Halaf period (represented in several sites, including Tepe Gawra; date about 4000 B.C.).

Jotham Johnson, formerly of University Museum, Philadelphia, speaks in a lighter vein[2] of a neolithic villager having discovered the usefulness of clay in cooking utensils "about nine thousand years ago." In a recent personal communication he states,

> The manufacture of pottery begins in the neolithic ("new stone") period, and it is in fact far more typical of the archaeology of that period than the improved technique of stone-working for which the period is named. It has been suggested that the term "ceramic" period be substituted and I am in favor of this.
>
> Very primitive pottery from the neolithic or "ceramic" period has been found widely in Egypt, western Asia, China, and southeastern Europe. The laboratory comparison of these local fabrics has lagged far behind their discovery, and it may be a decade or a generation before anyone can authoritatively state which is the oldest. It is highly probable that the discovery of the process was made independently in several different centres of culture diffusion at different times. In that case we will have no way of deciding between their rival claims.
>
> As for a date: since these primitive wares go far back of the invention of writing, it will not be possible to set an absolute date for the earliest. The earliest date in history is probably 3251 B.C. and nothing older will be found. The earliest pottery types have been referred to about 5500

[1] Hetty Goldman, "The Bronze Age Pottery of Greece," *Bull. Amer. Ceram. Soc.*, **13** [11] 301–308 (1934).

[2] Jotham Johnson, *Scientific American*, December, 1936.

B.C. Assuming that more ancient fabrics still await discovery, conservative investigators date the hypothetical origin about 6000, others back to 7000 or 8000. I favor a very conservative date between 6000 and 5500 B.C., but that is only my opinion.

Delougaz[3] describes ceramic objects found during exploration in Mesopotamia as "dating from the Early Dynastic period at the end of the fourth and beginning of the third millenium B.C."

Just when and where the first articles of clay were made will never be known. One may be as fanciful with respect to the origin of pottery as Charles Lamb concerning the origin of roast pig and probably be much nearer the truth.

Through the kindness of Charles H. Harder of the New York State College of Ceramics, Table II is given to show, in a general way, the historical progress of ceramic production. This is given as a suggestion for presenting a historical background in a very much condensed form. With further suggestions from others, such a tabulation might be shaped into a useful general reference or basis for a more detailed study of the pottery of any particular nation or of some definite type.

According to N. C. Debevoise of the Oriental Institute, University of Chicago, and other archaeologists, the chronological records of ancient culture, including ceramics, are practically complete so that an account of the historical development of ceramic ware may now be given with a fair degree of continuity.

A study of ancient ceramic products will stimulate interest not only in forms of ceramic art but in history, archaeology, geology, and other subjects. As an aid to conceptions of form and color for specific purposes, the study of old ceramic ware is invaluable. There is today nothing more graceful than the Greek vase; nothing as highly and as harmoniously colored as Ming porcelains; and nothing to compare with the soft beauty of Persian or Spanish luster tile. One can even obtain constructive ideas from a study of redware decorated by Zuñi Indian squaws.

VI

In leading one along the paths of creative ceramics, a historical sequence is most logical and almost automatically carries with it collateral interests so desirable to develop.

For instance, the first steps in clayworking or forming should involve nothing but the hands and a lump of soft clay. This reproduces the conditions under which the first pottery was made by primitive man. Some simple form is made, probably dish-shaped or bowl-shaped. As Dr. Goldman,[1] in speaking of early Greek pottery, states, "The early type of bowl is so simple and so adapted to the hand which fashioned and held it that it may well be thought of as an extension of the human hand itself."

The method of shaping which is simplest, most engaging, and most adaptable to self-expression is that of hand-forming or sculpture.

From this beginning, the worker may proceed along the historical path of clay-forming methods, such as coiling, molding, throwing (introducing the potter's wheel—centuries after hand-fashioned neolithic pottery), turning, casting, and machine molding.

The important possibilities of clay will be learned at the outset, and as the work proceeds through the various methods used for forming, a realization will develop as to the greater suitability of each method over others for specific design classifications.

VII

Decoration likewise may most advantageously be studied by following its historical sequence.

After the discovery that plastic clay could be shaped into useful articles, the decoration of such articles naturally followed; this decoration at first consisted of a simple finish secured by polishing, but it gradually developed through a great variety of elaborate and highly colored ornamental designs.

As with forming, the development of skill, good taste, and ambition in decorating will be helped by reference to classical examples of the past.

The earliest potters probably first resorted to scratched or incised designs of great simplicity. This no doubt was followed quickly by attaching pieces to form raised designs or useful components, such as handles and legs.

With an abundance of common clays of which some were red and others gray or buff, slip coating was begun at a very early period. This permitted cutting designs through a slip coat, thus originating the polychromatic decoration of simple clayware, which later was applied in principle to all other branches of the art, as shown today in the application of this method to the production of decorative paneling of vitreous enameled metals.

The technical ceramist ordinarily speaks of a glaze as a glass, rather suggesting the prior discovery of glass and its later adaptation to the glazing of ceramic ware. Among Egyptian antiquities, however, there is evidence of glazed stones and frits or siliceous tile, such as those of Kantir previously mentioned, which date back as far as 5000 to 4000 B.C., whereas glass does not commonly appear before approximately 1500 B.C.[4]

In Egypt, glazing was not used upon pottery or argillaceous ceramic ware until Ptolemaic times, some 4000 years after glazing had been applied to non-argillaceous or siliceous ceramic products. In Mesopotamia, however, glaze was used on pottery as early as 1500 B.C.

The discovery that ceramic ware could be glazed led to a greatly expanded field of decorative possibilities. At first, simple alkaline glazes were used in limited colors, chiefly blue, but the opportunities for extension soon became apparent.

If the chronological development of ceramic decoration were tabulated, it would probably follow the order suggested in Table III.

The order in which ceramic decoration has progressed since its beginning is suggested as the most natural and most effective sequence for teaching the art today.

[3] P. Delougaz, *The Illustrated London News*, December 3, 1938.

[4] N. C. Debevoise, "The History of Glaze and Its Place in the Ceramic Technique of ancient Seleucia on the Tigris," *Bull. Amer. Ceram. Soc.*, **13** [11] 293–300 (1934).

TABL

HISTORICAL DEVELOPMEN

Starting with well-developed products	4000–1500 B.C.	1500–500 B.C.	500 B.C –200 A.D.	200–900 A.D.	900–120
BABYLONIA AND ASSYRIA	Earliest ware Glazed and enameled brick, terra cotta and tile for architectural purposes Thought originators of TIN ENAMEL (Commerce with Egypt, Crete, Phoenicia)		Greek and Roman Influence	Heavy influx of Chinese influence (Samarra ware)	Persian Influence
EGYPT	Primitive REDWARE Bonded and geometric Blacktop redware GLAZED WARE begins Turquoise blueware Egyptian GLASS (Commerce with Aegeans and Babylonians)		Greek and Roman Influence		Persian Influence
AEGEAN COUNTRIES	Early Cretan or Minoan Period Creative period; redware decorated with marine motifs and abstractions in black, red, and white. Free and spontaneous in execution Later ware shows strong Egyptian influence	Greece Proper Earliest ware black on red with bands and geometric ornament Later ware begins use of human figure and animal forms in crude drawing but skillfully used as decoration, spontaneously executed Later period changes to red on black Drawing perfected, lines and forms refined			Persian Influence
ROME		Earliest ware similar to that of Crete, Babylonia, Egypt Thin soda glaze probably derived from Greece—ware fired oxidizing to produce the red of "Aretine ware" Pressing into molds used extensively "Sprig" molding This type of ware spread throughout the Empire	"Aretine ware" Terra Sigillata		
CHINA	Chou Dynasty Unglazed utilitarian ware. Occasional geometric and cross-hatched pattern Gray clay body. Ware of this period compares favorably with that of Egypt and Near East of same time		Han Dynasty Progress in technique and control Creative period Red, buff, gray bodies used. Mostly soft ware produced. Lead glazed ware begins, probably learned from the West. Colors mostly green and brown Forms adapted from bronzes. Large pieces done in clay fired at low temperatures STONEWARE	Tang Dynasty Both FAIENCE and stoneware bodies used at same time. Trend toward porcelain begun. Lead glazes in green, yellow, purple, brown, and black. High-temperature celadons. Slip painting and engobes used Technique improved (commerce with West)	Su Period produced PORCELAIN mastered Beautiful realiz texture, form, acterized by si great apprecia possibilities of
PERSIA (Near East)		Primitive ware—sometimes glazed, occasionally polished and varnished. Shows Egyptian, Babylonian, and Hellenistic influence		Arab Period Mohammed Improved forms glazed ware — mostly green LUSTRE WARE ON A TIN ENAMEL probably derived from Babylonia. Arabic lettering used decoratively. Polychrome-Rhages ware Beginning of fine period in Near East pottery	
HISPANO-MORESQUE			Early ware of Spain and Italy similar in character to those of Crete, Babylon, Egypt Ware of the Early Christian Period shows Roman influence		Moors enter Spain secrets of the Pe Lustre on the tin e Arabesque ornament Turkish motifs
ITALY					
FRANCE					
ENGLAND				Ware showing Roman origin made in Britain at this time	Coarse glaze lead
GERMANY					

TABLE II

PMENT OF CERAMIC PRODUCTS

–1200 A.D.	1200–1400 A.D.	1500 A.D.	1600 A.D.	1700 A.D.	1800 A.D.
Persian Influence					
Persian Influence					
Persian Influence					
Sung Dynasty luced some of finest of Chinese LAINS. Materials control realization of subtleties of form, and color. Ware char- by simplicity, dignity. Shows preciation of limitations and ies of the "reducing fire"		Ming Dynasty Early Ming, a continuation of ware made during Sung Period Western influence begins to make itself felt in form and decoration. Later period shows display of extreme skill, with consequent overelaboration of form and ornament Low-temperature enamels in many colors	Decline Begins	Unsuccessful efforts to revive earlier ware	
	Seljuk-Turkish Period Manufacture of TILE predominates Chinese influence marked in form and ornament. Some of the most beautiful ware produced in this Period. Damascus and Rhodian ware. Turks conquer Asia Minor and parts of Europe, spreading arts of the Near East	Mongol Period A Period showing increasing Chinese influence. Techniques remain essentially the same. New symbols and ornament adopted. Trade routes opened through Persia from Europe to China Period lasted nearly 400 years	Ware of this type still made in many parts of Near East		
Spain bringing the e Persian potters— e tin enamel glaze ament; Persian and ifs	Moors expelled, 1492 Pottery processes undergo a change. Persian style becomes diluted with Early Christian decorative motifs. Manufacture of so-called MAJOLICA ware begins. Painting on a tin enamel glaze				
	"Pottery towns" appear in Italy; Faienza, Deruta, Urbino, Castel Furante; Gubbio lustre ware	Repeated attempts to duplicate Chinese porcelain			
	Manufacture of FAIENCE begun at St. Cloud, Rouen, Lille. Work shows strong Italian influence. May have been done by Italian workmen	"Soft porcelain" made in France			
Coarse utility jugs and pots, glazed with a simple wash of lead ore	Potteries centered around Staffordshire, although still a peasant industry		SLIPWARE: similar ware produced by other potters of the region	Ellers Brothers import method of making SALT-GLAZE and red stoneware	BONE CHINA
			Germans manufacture red stoneware and salt-glazed ware	Böttger discovers secret of hard porcelain at Meissen (Dresden)	

TABLE III

CHRONOLOGICAL DEVELOPMENT OF CERAMIC DECORATION

Polishing
Incising
Impressing or stamping
Glazing of nonargillaceous ware
Painting
Relief
Slip coating
Graffito (cutting through slip coating to produce design in the color of the underlying ware)
Glazing of all types of ceramic ware
  Clear glazes, Colored glazes } With underglaze and overglaze designs
Enameling
  Designs over enamel
  Luster ware
Salt glazing (the first of vapor glazes)
Specialty glazes
  Crackled
  Crystalline
  Cloisonné and champlevé (in tile and vitreous enamels)
Metallic banding

VIII

"Art is not a thing separate and apart. Art is simply the best way of doing things."

—*Elbert Hubbard*

With some knowledge of the ways in which clays and allied materials may be shaped and decorated and of the field of usefulness of the finished articles, the young worker is ready for original design and execution.

In designing and in the selection of materials, there should be a definite purpose and, of course, the highest possible degree of suitability in shape and material for the use which is to be made of the article, *i.e.*, high functional value.

Recently at an afternoon tea the speaker was handed a square cup and saucer of foreign production. The tea readily ran from the corners of the cup upon one's collar if great care was not exercised, the cup handle was a square, cross-barred affair through which a finger could not fit but could only be squeezed tightly between the thumb and finger for holding, and the cup would not stay centered upon the square saucer. In addition to being a liability to the user, this unique affair was probably as great a trial to the maid whose duty it was to restore cleanliness to the tea service.

Upon another occasion, there appeared a water pitcher glazed in imitation of wood, with grain, knots, "and everything." Why should a ceramic product be made to look like a wooden article, especially for holding water?

In designing, one should make pitchers that pour easily, coffee pots from which the tops do not fall off and splash into one's cup just as it is filled, teacups that may be held firmly and gracefully, table and kitchen articles that may be cleaned readily and thoroughly, and in all cases articles that serve their purpose well.

Choice and arrangement of colored decoration is an important part of designing. In these days of color consciousness and color experts, designer-craftsmen will find it advisable to use pleasing and suitable colors and may readily secure professional advice in color selection for special applications.

In the speaker's opinion, the predominance of red in salad plate decoration would detract from the desired

Fig. 1.—Athenian girl weaving. Lekythos vase, about 500 B.C. (British Museum, London).

effect of refreshing coolness and daintiness. If green is selected as the predominating color, a great difference in greens will be found, the light shades having a fresh, clean look and the very dark shades, a cheap, unhealthful look.

Pansies used as underglaze decoration for a meat platter do not help very much—to be extreme in statement. If the meat being served were beef, the hostess might be suspected of carrying unnecessarily far the weakness of Ferdinand the Bull.

Multicolored majolica used for luncheon in the open air along the shores of Lake Como upon a bright sunny day in May harmonizes beautifully with the reflected colors of the flower gardens along the water's edge and gives one a sense of serenity and satisfaction. The same ware used for a formal dinner at the Savoy in London would have an entirely different effect.

Howard Ketcham concludes an article in *Harper's Bazaar* of February, 1937, as follows:

> The world of color is large, complex, and unexplored, but at the same time, familiar and intricate. For, as Grant Allen pointed out in his essay on comparative psychology, "There is no element in our sensuous nature which yields us greater or more varied pleasure than the perception of color. The pleasure of color is one which raises itself above the common level of monopolistic gratification and attains to the higher plane of aesthetic delight."

Thus an understanding of color forms an essential part of our general culture.

Likewise Franklin Brill has this to say in an article appearing in *Modern Plastics* for October, 1938:

As any designer instinctively knows, color has the property of conveying emotional reactions to the observer. Thus, reds, oranges, and variations of these colors convey a feeling of warmth; blues and greens are cool. (Laundries and bakeries have repeatedly reduced complaints of heat by painting walls in light ice-blues; and it is an old rule of the theatre never to play a comedy scene under anything but yellow light.) In fact, various colors can make a product look larger, smaller, heavier, or lighter; rich, soothing, expensive, hot, cool, clean, strong, or stimulating. Such color reactions should be studied before approaching any color selection job, for while they are by no means infallible they cannot be ignored without leading to the selection of colors which are unsuited to a product's function. These connotations are listed below.

Here is what colors mean in the opinion of some color authorities. But individuals, market peculiarities, competition, or other associations can sometimes knock any one of them into a cocked hat, as can the use of certain shades, tints, or modifications of each color.

Red: Fire, heat, excitement, strength
Rose: Daintiness, softness, fragrance, freshness
Orange: Warmth, action, power, tastiness
Maroon: Richness, solidity, luxury, quietness
Yellow: Brightness, airiness, refreshment
Dark blue: Coldness, formality, haughtiness
Light blue: Coolness, fragility, daintiness, youthfulness
Dark green: Unhealthfulness, cheapness, coldness
Light green: Freshness, crispness, coolness
Purple: Royalty, stateliness, opulence
Lavender: Fragrance, richness, refinement
Brown: Wholesome and mellowness; utility
Gray: Mildness, softness, reserve, primness
White: Purity, professionalism, cleanliness, chastity
Black: Strength, mystery, heaviness, coldness

The designer must give some consideration to the body material used in articles for specific uses. Mexican water jars made of a vitrified or nonporous material would prove entirely useless in comparison with the highly porous pottery purposely used to provide slow leakage, surface evaporation, and a resultant maintenance of coolness. When using clay compositions, porous structures are usually best for heat resistance.

Objects to be used outdoors should be weather-resistant and therefore impervious. Obviously floor or porch tile should be tough and abrasion-resistant. Articles with a purely ornamental purpose may cover a wide range of physical properties but should be suited to carry the scheme of decoration proposed.

Purpose in designing is always essential but need not be a single purpose. Ware may be made to satisfy simultaneously definitely useful functions, please the eye, withstand hard usage, and even provide enduring records of current life and events.

When the Assyrians and Babylonians wrote on clay, they permanently recorded the life of the times in the very best way.[5]

Fig. 2.—Greek women weaving and spinning, on a black-figured vase, 6th Century B.C. The weights attached to the bundles of warp-threads are plainly seen (Metropolitan Museum of Art, New York).

Fig. 3.—Penelope and Telemachos before a high-warp loom, showing an unfinished tapestry; so-called Penelope vase from Chiusi, dated about 400 B.C. Red figures on black ground.

[5] Edward Chiera, They Wrote on Clay. G. G. Cameron, Editor, University of Chicago Press, Chicago, Ill., September, 1938.

As a simple instance of recording another industry or art by means of the ceramic art, the accompanying illustrations, which appeared in *Ciba Review*, No. 16, December, 1938, are reproduced here through the courtesy of the Society of Chemical Industry in Basle, Switzerland, and Ciba Company, Inc., of New York.

This recording of persons, processes, and events has not been confined to the ancients but has been practiced in quite modern times. In an article entitled "Railway History in Pottery," John Phillimore[6] describes English pottery made in the forms of mugs, jugs, and bowls of varying shapes and sizes decorated with scenes of the early railway equipment during the years when railways were the wonder of the world, that is, the early part of the nineteenth century. Various early types of engines and cars are shown as used over a period of fifteen or twenty years when railway equipment was changing rapidly. It is the speaker's impression that the New York Central and Pennsylvania Railroads (or the Pullman Company) have done something along this line in getting out commemorative plates with railway scenes for dining-car service, these being mostly in blue and white or brown and white.

"The art preservative of all arts" surely may be applied to ceramics with full justification.

Symbolism may also form part of the designer's objective as well as direct portrayal.

This, of course, is especially predominant in the decorations of crude Indian pottery, and also in the decoration of classical Chinese porcelain—the aristocrat of all ceramic ware—every detail has its significance. An understanding of these symbolisms adds substantially to an appreciation of the ware.

IX

It is hardly probable that a worker in ceramic materials can proceed far without evincing some interest in the occurrence and properties of the raw materials which he uses.

Why are some clays red after firing and others buff, gray, and white?

Why is a white-firing clay usually much less plastic and more refractory than a very dark-colored clay?

Where are workable clays most likely to be found?

Metallic oxides each produce some characteristic color in glazes, but with a certain few oxides a range of widely different colors may be produced. With only copper oxide, how did the Chinese potters secure such beautiful red as their "sang-de-boeuf" or the delicate shade of their famous "peach bloom," as well as a variety of colors ranging from blue to green?[7]

How are crystalline glazes formed?

Correct answers to such questions carry one into the realms of geology, mineralogy, chemistry, and physics.

X

There is certainly much to be told concerning ceramics as an art or to supplement its presentation as a cultural subject.

Orton's work provided a better educational and inspirational background for the engineering and industrial phases of ceramics. There is a great opportunity and need today for a broader educational and inspirational background in the art phase of ceramics which Orton made no attempt to cover.

Ceramics is a great art, an art of which the members of this Society may well be proud. Extending back beyond the dawn of history, it has been practiced by all branches of the human race and its products have been used for the service and pleasure of mankind in innumerable ways. Pottery-making has a fascination for old and young, and the simplest creation of the fingers may be at once pleasing in appearance and of practical usefulness.

In the speaker's opinion, the ceramic art would benefit in direct practice, utilization, appreciation, and in serving better as an educational subject if there were better coördination and dissemination of information concerning it.

In any scheme of coördination, there should be a major center in which information is collected, edited, and distributed, in which outstanding exhibits both of ancient and modern classical ware are available (as in museums, galleries, and private collections), in which well-qualified teachers for the practice of each branch of ceramic art are procurable, and in which there are opportunities for reaching a large number of people by exhibits, lectures, and sales of the products of designer-craftsmen. It should be a place also where the product of beginners may be fired or where they may obtain small supplies of necessary raw materials. Many lesser features could well be included.

A great interest is shown by present-day educators in ceramic art, as manifested by the large and increasing number of classes. Its unique and readily developed educational values are generally recognized. The ease with which some branches of the art may be initially practiced provides an early indication of pupil ability in originality, concentration, and coördination. The great variety, wide distribution, and universal usefulness of ceramic products quite probably exceed that of any other art or craft. There is a wealth of historic and romantic interest in every branch of ceramics. Ceramics, which involves drawing, painting, and sculpture to a greater extent than these arts involve ceramics, is therefore more comprehensive.

For these reasons, those of us directly interested in ceramics should, upon all appropriate occasions, point out its unique and interesting features as an art, an educational project, and as a source of innumerable, decorative, and widely useful products. In time, this will result in a more general recognition of ceramics as perhaps not the least of the major arts.

General Electric Company
Schenectady, New York

[6] *The Connoisseur*, May, 1938.

[7] A. L. Hetherington, Chinese Ceramic Glazes. Cambridge University Press, 1937.

FROTH FLOTATION AND AGGLOMERATE TABLING OF FELDSPARS*

By R. G. O'Meara, J. E. Norman, and Walter E. Hammond†

Abstract

Highly selective methods for separating soda and potash feldspars from quartz both by froth flotation and table agglomeration are described. These separations are far ahead of any previously reported separation, and high-grade feldspar and quartz concentrates are possible. Cationic reagents as collectors are necessary. Cleaning of the mineral particles by removing kaolinization products, iron, and aluminum compounds by mechanical and chemical methods is described. As pulp modifiers, a variety of fluorine-bearing acids and salts is shown to be outstanding in the depression of quartz and activation of feldspar, especially in an acidic pulp. The laboratory results have been checked on a pilot plant scale; results from a commercial plant have been delayed by damage of the New England hurricane in 1938, which caused recess of construction for the winter months.

I. Introduction

The feldspars may be divided into two main groups, *viz.*, (1) orthoclase or microcline and (2) plagioclase, an isomorphous mixture of albite and anorthite. Albite and microcline are the most important commercial feldspars, but the marketed products usually contain varying proportions of the other members of the system. The granites and pegmatites, consisting of feldspar, quartz, and mica, constitute the feldspar reserves of the United States. With the present methods of production, however, the pegmatites, being coarse-grained, are the source of industrial feldspar. The usual practice in winning the material consists in selective mining and handpicking, followed by grinding, screening, and magnetic concentration. Aside from the separation of the magnetic material, the only beneficiation in the milling is obtained through the differential grindability of the associated minerals whereby the coarse mica is separated in screening; the main impurities remaining in the ground feldspar therefore are quartz and fine mica. The feldspars are used for the alumina and alkali-metal content in glasses, glazes, enamels, tile, and porcelain. There are numerous trade feldspars differing in size-range, proportion of alumina, and proportion of the alkalis.

In spite of the fact that both feldspar and quartz are used in the same ceramic products, the consumers prefer to add them separately as high-grade mineral products. The separation of feldspar from quartz consequently has been the objective of numerous experimenters, both to conform to the demands of the trade and to benefit the producers. Unless the minerals are high grade and coarsely crystalline, the mining costs frequently are prohibitive because of the material rejected in the mining and handpicking. Although the reserves of feldspar are large, the assurance of a constant supply of pure feldspar is not yet attained. With a satisfactory method of beneficiation, both the material rejected in the present mining and the ore of too low grade or too disseminated, such as granites, could be utilized. The development of a satisfactory process depends not only upon separation of the feldspar but also upon the maintenance of a proper size ratio of the particles of feldspar to meet the trade requirements. The specifications of sizes range from as coarse as −20-mesh + 100-mesh to a size as fine as −200-mesh.

In the past, various methods of separation, such as differential grinding and sizing, gravity concentration, electrostatic separation, and flotation, have been considered. Each process has been only partly successful or has failed because of unsuitability of the size range or lack of selectivity. Of the methods commonly used in ore dressing, however, flotation or some modification of it offered the most promise.

In 1936, under the supervision of Oliver C. Ralston,‡ the Bureau, in coöperation with the University of Alabama, began an investigation of the concentration of feldspar by froth flotation and agglomerate tabling. Both methods of concentration depend upon the surface properties; flotation is suitable for fines and agglomerate tabling for coarse material. By utilizing the two methods, a separation based on surface properties may be applied to a range of sizes greater than for either method singly.

Later, in coöperation with the Golding-Keene Company, Keene, New Hampshire, the laboratory work was completed, and the process was tested further in a pilot plant at Keene. A description of the laboratory work is presented, the latter part of which was done in the pilot plant.

II. Laboratory Tests

Feldspars from North Carolina, New Hampshire, and Colorado and the wasted fines from a granite quarry in Georgia were tested in the laboratory. Most of the work, however, was confined to a soda feldspar from New Hampshire and a potash feldspar from North Carolina as follows:

(1) Keene feldspar: Graphic granite from the Alstead mine of the Golding-Keene Co., Keene, N. H.; the mineral ore contained about 50% each of albite and quartz and about 0.3% mica; the material was waste that had accumulated during a number of years of mining.

(2) Bandana feldspar: Badly weathered potash feld-

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‡ Chief Engineer, Nonmetals Division, Bureau of Mines.

spar from the Bandana mine of the Southern Feldspar Corp., Tocane, N. C.; the material was mainly feldspar and quartz with about 2% mica.

Inasmuch as the results on these two minerals were typical of the separations of soda and potash feldspars from quartz, the results on the others are omitted, except in the discussion of the process where they are introduced to illustrate a particular point.

Briefly, the laboratory practice consisted of dry-grinding through 20-mesh, screening the product on 48-mesh, agglomerating and tabling the oversize, and froth flotation of the fines. To conform with the trade requirements, −20-mesh was selected for the initial grind, and fortunately this size was fine enough to liberate the mineral constituents. The degree of further sizing for agglomerate tabling and flotation was determined by trial. The −48-mesh product was fine enough for flotation. The 20- to 48-mesh size was coarse enough so that the unoiled quartz was not washed across the concentrating table by the current of water necessary to buoy the coarse, oiled feldspar agglomerates. Usually a single tabling or floating was enough; cleaning was attempted, but it was unnecessary if the reagents were balanced and the pulps were properly conditioned.

The cationic type of collectors, which are most satisfactory for acidic minerals, were used in the flotation and agglomerate tabling. The reagents of this type included lauryl amine hydrochloride, trimethyl stearyl ammonium bromide, lauryl pyridinium iodide, trimethyl cetyl ammonium bromide, Ninols 521, 517, and 57A, and Armour amine salts. Du Pont reagents C and N were also tested. The former is cetyl betaine, with the cetyl group linked to a carbon atom of the betaine, while the latter is stearyl betaine, having the stearyl group attached to the nitrogen of the betaine. As betaine itself is an inner salt, having an acidic and a basic group, these reagents possess both cationic and anionic properties. Lauryl amine hydrochloride has the general properties of the cationic group and was selected for most of the testing. Without modifiers, a small amount of the collectors floated both feldspar and quartz, but the selective flotation and agglomerating of feldspar were controlled by small amounts either of one or both fluorine-bearing compounds or acids. Of the fluorine compounds, hydrofluoric acid gave the more satisfactory results and was used in most instances.

The results of the agglomerate tabling and flotation tests on the Keene and Bandana feldspars are given in Tables I and II.

TABLE I

AGGLOMERATE TABLING AND FLOTATION TESTS ON KEENE FELDSPAR

Reagents in agglomerate tabling and flotation tests

Reagent	Lb./ton feed treated: Flotation	Lb./ton feed treated: Agglomerate tabling
Hydrofluoric acid	2.30	2.30
Lauryl amine hydrochloride	0.24	0.24
Fuel oil		5.40

Agglomerate tabling test of −20-mesh + 48-mesh part of feed (64.2 % of weight of feed)

Product	Weight (%)	Assay % Al_2O_3	Distribution of Al_2O_3 (%)
Agglomerate concentrate	44.9	19.18	94.6
Table tailing	55.1	0.89	5.4
Composite	100.0	9.10	100.0

TABLE I (*continued*)

Flotation test of −48-mesh part of feed (35.8% of weight of feed)

Product	Weight (%)	Assay % Al_2O_3	Distribution of Al_2O_3 (%)
Rougher concentrate	58.5	19.63	97.9
Rougher tailing	41.5	0.59	2.1
Composite	100.0	11.73	100.0

Results of combined agglomerate tabling and flotation tests

Product		Weight (%)	Assay % Al_2O_3	Distribution of Al_2O_3 (%)
Agglomeration and flotation	Concentrate	49.8	19.34	96.1
	Tailing	50.2	0.78	3.9
Composite		100.0	10.03	100.0

TABLE II

AGGLOMERATE TABLING AND FLOTATION TEST ON BANDANA FELDSPAR

Reagents in agglomerate tabling and flotation tests

Reagent	Lb./ton feed treated: Flotation	Lb./ton feed treated: Agglomerate tabling
Hydrofluoric acid	3.00	3.00
Lauryl amine hydrochloride	0.80	0.48
Fuel oil		10.00

Agglomerate tabling test of −20-mesh + 48-mesh part of feed (51.5% of weight of feed)

Product	Weight (%)	Assay % Al_2O_3	Distribution of Al_2O_3 (%)
Agglomerate concentrate	69.7	18.60	99.7
Table tailing	30.3	0.10	0.3
Composite	100.0	12.98	100.0

Flotation test of −48-mesh part of feed (48.5% of weight of feed)

Product	Weight (%)	Assay % Al_2O_3	Distribution of Al_2O_3 (%)
Rougher concentrate	79.4	19.18	98.1
Rougher tailing	20.6	1.44	1.9
Composite	100.0	15.53	100.0

Results of combined agglomerate tabling and flotation tests

Product		Weight (%)	Assay % Al_2O_3	Distribution of Al_2O_3 (%)
Agglomerate and flotation	Concentrate	74.4	18.88	98.9
	Tailing	25.6	0.75	1.1
Composite		100.0	14.23	100.0

The tests were evaluated by chemical analyses for Al_2O_3 and were checked by microscopic examination of the products. Assays for K_2O and Na_2O were omitted because the alkali metal content is less important and because the objective was the separation of feldspar from quartz rather than separation of the feldspars from each other. Both the soda and the potash feldspars were amenable to flotation and agglomerate tabling. Slight adjustments of the

amounts of reagents were required, but the same general procedure was satisfactory. The Bandana ore, being badly weathered, required more collecting and conditioning reagents than the Keene ore.

III. Discussion of Process

In assessing the reagents for the flotation and agglomerate tabling, the cationic reagents were tested in neutral, alkaline, and acidic circuits. In slightly alkaline circuits, quartz tended to float, whereas in acidic circuits the feldspar floated. The type of acid used, however, had a marked effect on the separation. The acids tested with lauryl amine hydrochloride were hydrochloric, sulfuric, hydriodic, hydrobromic, iodic, hydrofluoric, nitric, hydrofluosilicic, formic, fumeric, maleic, and acetic. The results showed that acids usually had a depressing effect on the quartz, and the fluorine-bearing acids or acid salts were the most effective.

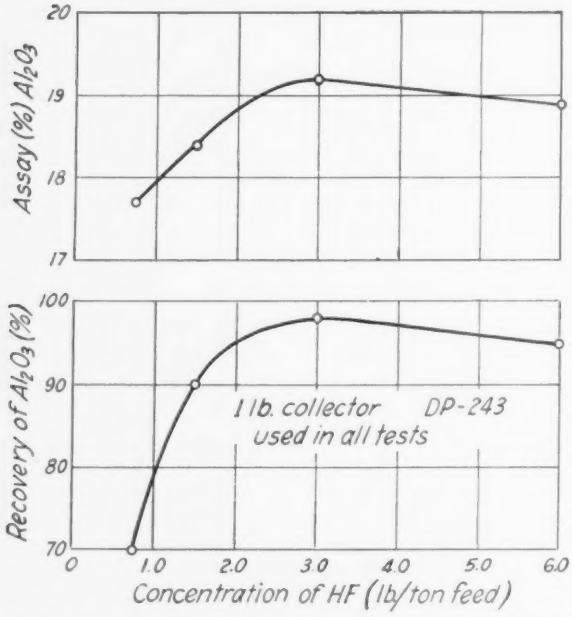

FIG. 1.—Effect of hydrofluoric acid on recovery and grade of feldspar in the concentrate.

Two series of flotation tests were made on the Keene feldspar to compare the effect of hydrofluoric and hydrochloric acids and to show the effect of different concentrations of each. The results in Figs. 1 and 2 show that hydrofluoric acid is more selective and requires less careful control than hydrochloric acid. With hydrofluoric acid, the grade and recovery of feldspar concentrate increased as the acid concentration increased to 4.0 lb. per ton of feed,* and neither was markedly lower with concentrations of 6.0 lb. With hydrochloric acid, the grade of concentrate increased up to 0.2 lb. and then decreased; furthermore, the recovery decreased throughout the series. A similar series of tests was made with lauryl amine hydrochloride and different amounts of hydrochloric acid to show the effect of p_H on the recovery and grade of feldspar. The results are shown in Fig. 3. The selectivity of the collector for feldspar was a maximum at a p_H of 2.1. At a p_H of 4.2, quartz tended to float, and at a p_H of 7.8 to 8.2, quartz floated in preference to feldspar. This effect of p_H was noted both in flotation and agglomerate tabling.

Some of the reagents, such as Du Pont reagent C, reagent N, and trimethyl stearyl ammonium bromide, showed a natural tendency to float quartz from feldspar. The natural preference was probably due to the reagent having a higher p_H than some of the other collectors. The best results were obtained at a p_H of 7.5 to 7.8. A number of alkalis and basic metal salts were tested to improve

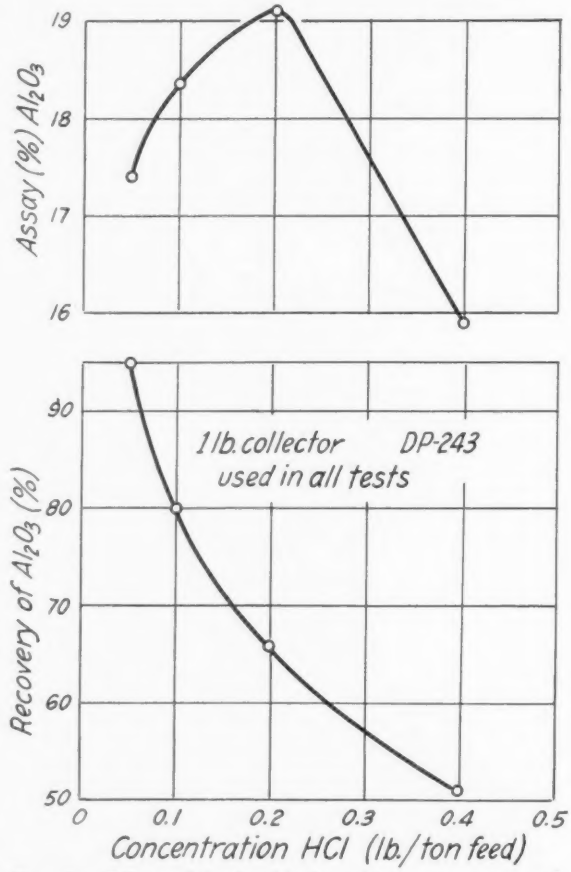

FIG. 2.—Effect of hydrochloric acid on recovery and grade of feldspar in the concentrate.

the separation. In the agglomerate tabling tests with trimethyl stearyl ammonium bromide, either ammonium hydroxide or lead acetate gave the best results of any of the several that were tried. The tests are recorded in Table III.

In these tests, the first agglomerate concentrates were re-tabled to improve the grade. With reagents C and N, the best results were obtained with aluminum sulfate. The effect of different amounts of aluminum sulfate with reagent C on Keene soda feldspar is shown in Fig. 4. The separation of quartz from feldspar by the activation of quartz was not as satisfactory as the separation of feldspar

* Hereafter when "pounds" are mentioned, "per ton of feed" is understood.

TABLE III

AGGLOMERATING AND TABLING OF QUARTZ FROM FELDSPAR

(−20-mesh + 48-mesh part of rock)

Reagent (lb.)		Product	Weight (%)	Assay % Al_2O_3	Distribution of Al_2O_3 (%)
Keene feldspar					
Trimethyl stearyl ammonium bromide	0.10	Agglomerate concentrate	54.5	2.10	16.3
Ammonium hydroxide	0.24	Middling	24.6	10.90	38.2
		Tailing	20.9	15.20	45.5
Fuel oil	3.00	Composite	100.0	7.00	100.0
Bandana feldspar					
Trimethyl stearyl ammonium bromide	0.10	Agglomerate concentrate	28.2	6.10	13.4
Lead acetate	2.00	Middling	17.0	11.30	15.1
		Tailing	54.8	16.70	71.5
Fuel oil	3.00	Composite	100.0	12.81	100.0

from quartz by the activation of feldspar, nor could the separation in the first instance be predicted with the same certainty.

All of the feldspar and quartz mixtures in their natural state do not behave the same in agglomerate tabling and flotation, probably because the rocks have been weathered and leached in the ground for many years and are badly

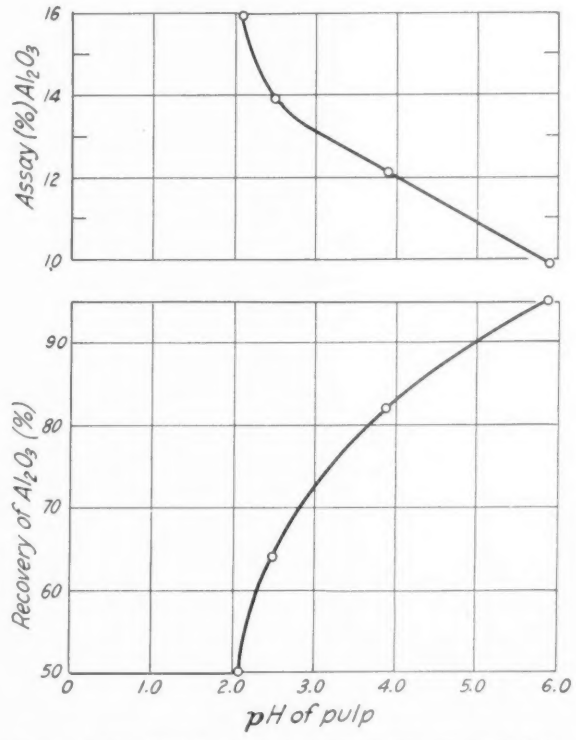

FIG. 3.—Effect of p_H on the recovery and grade of feldspar in the concentrate.

contaminated with alteration products. That feldspar is readily altered is evidenced by the crumbly alteration products present at abandoned mines. Weathering and ground water undoubtedly have had their effect on feldspar, even though the alteration is not visible, and thus the associated minerals have been activated or deactivated.

One potash feldspar from Spruce Pine was so altered that the quartz floated from the feldspar in a strongly acidic circuit. The results of a flotation test on this ore are shown in Table IV.

TABLE IV

FLOTATION OF NATURALLY ACTIVATED FELDSPAR ROCK

Reagent	Lb./ton of feed: Rougher	Cleaner No. 1	Cleaner No. 2
Trimethyl stearyl ammonium bromide	0.2		
Hydrochloric acid	0.1	0.4	0.4

Product	Weight (%)	Assay % Al_2O_3	Distribution of Al_2O_3(%)
Cleaner concentrate	16.7	7.80	8.9
Middling No. 2	12.4	7.20	6.1
" " 1	7.9	9.70	5.3
Rougher tailing	63.0	18.40	79.7
Composite	100.0	14.60	100.0

The minerals floated in the roughing acted as one mineral because all of the products separated in the two cleaning operations were about the same grade in alumina.

A number of explanations has been offered for the difference in the flotation properties of natural feldspar-quartz products. One of the most plausible is that iron and aluminum salts are adsorbed on the feldspar and quartz, altering the surface properties. It is known, moreover, that the removal of the claylike alteration products by dispersing agents and by salts or acids which form complex or only slightly ionized salts is advantageous. The fluorides and fluorine compounds have special merit in this complexing and removal. Other investigators, using anionic reagents, have recognized the activating effects of iron and aluminum salts for floating feldspar from quartz; with cationic reagents, however, quartz tended to float in preference to feldspar. When the feldspar is freed from the adsorbed salts and claylike alteration products, it floats in the acid circuit with lauryl amine hydrochloride, and the cleaned quartz is depressed. Hydrofluoric and hydrofluosilicic acids and their salts react in an acidic circuit with ferrous, ferric, and aluminum ions to form slightly ionized or insoluble fluorides and fluosilicates.

This theory is substantiated by the following experimental data. As discussed in the paragraph on reversal of flotation, the addition of aluminum salts depressed feldspar, and the effect of aluminum sulfate is shown in Fig. 4. If the aluminum and iron compounds, however, are not in excess of stoichiometric proportions of fluorine-bearing compounds, the feldspar is not depressed. Table V gives the effect of aluminum sulfate and ferric ammonium sulfate, in different proportions, on the efficiency of the separation; tests with fluorine-bearing salts and acids are also shown for comparison.

TABLE V

EFFECT OF ALUMINUM AND IRON SALTS ON SEPARATION OF FELDSPAR WITH LAURYL AMINE HYDROCHLORIDE AND COMPARATIVE TESTS WITH FLUORINE-BEARING SALTS AND ACIDS

Reagent	Results
Ferric ammonium sulfate equivalent to 3 lb. HF + 6 lb. HF	Practically complete separation of feldspar from quartz
Ferric ammonium sulfate equivalent to 12.4 lb. HF + 6 lb. HF	15–25% feldspar in quartz tailing
Aluminum sulfate equivalent to 7.8 lb. HF + 6 lb. HF	About 35% feldspar in quartz tailing
2–5 lb. HF	2–5% feldspar in quartz tailing
5 lb. Na_2SiF_6 + 3 lb. H_2SO_4	±2 " " " " "
5 lb. NaF + 5 lb. H_2SO_4	±5 " " " " "
Fluosilicic acid (H_2SiF_6)	±5 " " " " "
5–8 lb. CaF_2 + 3 lb. H_2SO_4	±7 " " " " "
3 lb. H_2SO_4	±10 " " " " "

Some flotation tests were made on the Keene feldspar with lauryl amine hydrochloride in an iron-free circuit in which sulfuric acid was substituted for hydrofluoric acid. The concentrates assayed about 15% quartz and the tailings, about 15% feldspar. Iron salts alone obviously were not responsible for the results being poorer than those obtained with hydrofluoric acid. After a consideration of the iron, aluminum dissolved in the acid circuit appeared to be the next most likely contaminant. The adsorption of this ion would render the feldspar more basic and less floatable with lauryl amine hydrochloride. The soluble aluminum, for this reason, could be advantageously removed by hydrofluoric acid as aluminum fluoride or by sodium hydroxide as sodium aluminate.

Two tests were made on the Keene feldspar to verify this statement. In one test, it was treated with 5.0 lb. of sodium hydroxide, filtered, washed, and floated with lauryl amine hydrochloride and sulfuric acid; the tailing was about 95% quartz. In the other test, the rock was treated with 5 lb. of sodium hydroxide, acidified with sulfuric acid, and floated with lauryl amine hydrochloride. In this case, without washing the feed, the tailing contained less than 90% quartz and was noticeably less pure than when the alteration products were removed.

Another test supports the theory of the adsorption of alumina. The feldspar was subjected to flotation with oleic acid, pine oil, and a trace of soda ash. Much slimy material and about 10% of the granular quartz and feldspar floated. Oleic acid filmed and floated mineral grains carrying large amounts of adsorbed alumina. The charge was then acidified with sulfuric acid and lauryl amine hydrochloride was added. The feldspar floated so freely that the tailing was 95% quartz. This removal seems to be necessary to separate clean quartz tailings.

When the Keene feldspar was treated with 5.0 lb. of hydrofluoric acid, washed, and floated with lauryl amine hydrochloride and with sulfuric acid instead of hydrofluoric acid, a clean quartz tailing was made, but the concentrate contained 15% quartz. This grade of concentrate corresponded to concentrates obtained from the feed that had been washed with sodium hydroxide. A possible explanation of the low-grade concentrate is that hydrofluoric acid was necessary to act as a dispersant either for quartz or feldspar during flotation to remove fine particles

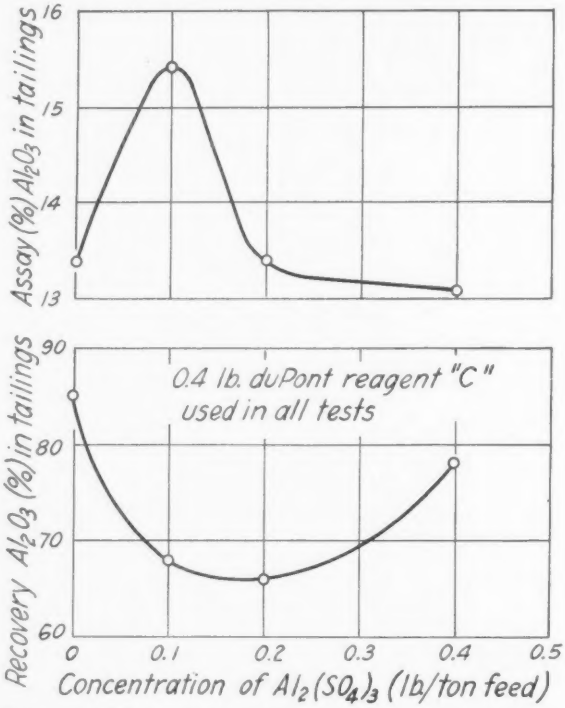

FIG. 4.—Effect of aluminum sulfate for depressing feldspar.

of feldspar from the surface of quartz which would otherwise float with the feldspar. A poor concentrate was obtained when the rock was treated with sodium hydroxide, soda ash, Daxad, or sodium silicate and was washed and floated with lauryl amine hydrochloride. The grade of concentrate likewise was reduced further by increasing the amount of fines. (The dispersing action of hydrofluoric or hydrofluosilicic acid has been demonstrated in dispersing clay from diatomite in a distinctly acid slurry.)

The differences in the action of hydrofluoric and sulfuric acid (sulfuric acid being typical of the less satisfactory acids) may be summarized as follows: (1) sulfuric acid dissolves slightly soluble iron and aluminum compounds and forms salts that ionize and depress the feldspar, whereas hydrofluoric acid (although it dissolves these compounds) forms salts that are only slightly ionized; and (2) hydrofluoric acid acts as a dispersant, removing fine feldspar particles from the quartz, thus leaving the quartz

in an inert state; sulfuric acid does not have this cleansing effect.

IV. Modification of the Process

In the flotation and in the agglomerate tabling, mica and weathered feldspar increased the consumption of reagents. In fact, in most of the tests on the badly weathered Bandana feldspar, excessive amounts of reagents were used, but the amount of collector could be decreased greatly by modifying the process. One sample of the Bandana feldspar required 6.0 lb. of lauryl amine hydrochloride. Two different procedures were tested to reduce the consumption of reagents. One method was to disperse the weathered material by blunging the pulp before flotation and to remove the dispersed product by decantation. The required amount of collector was decreased from 6.0 to 1.0 lb. by this procedure. The other method was a flotation procedure in which the dispersed weathered material and mica were removed. To make this removal, a short-chain amine (such as triamyl amine) was used to float the clay alone before separating the feldspar. The feldspar was then floated from the same pulp with only 0.2 lb. of lauryl amine hydrochloride.

TABLE VI

FLOTATION TESTS SHOWING EFFECT OF REMOVING WEATHERED FELDSPAR ON REAGENT CONSUMPTION OF BANDANA FELDSPAR

Reagent (lb.)		Product	Weight (%)	Assay % Al_2O_3	Distribution of Al_2O_3 (%)
Untreated rock					
DP-243*	6.0	Concentrate	73.5	19.00	88.0
HF	3.0	Tailing	26.5	7.20	12.0
		Composite	100.0	15.87	100.0
Blunged (10 min.) and slime decanted					
DP-243*	0.96	Concentrate	78.3	19.10	99.57
HF	3.0	Tailing	21.7	0.30	0.43
		Composite	100.0	15.02	100.00
Weathered material removed by flotation using 0.16 lb. of triamyl amine					
DP-243*	0.20	Concentrate	78.3	18.60	98.6
HF	3.0	Tailing	21.7	0.90	1.4
		Composite	100.0	14.70	100.0

*Lauryl amine hydrochloride.

Table VI gives the results of these tests on the Bandana feldspar. In these tests, the grade of concentrate was about the same, but the recovery was increased by removing the slime.

TABLE VII

AGGLOMERATE TABLING OF MICA BEFORE SEPARATION OF FELDSPAR FROM QUARTZ

Reagent (lb.)		Product	Weight (%)	Assay % mica	Distribution of mica (%)
Lauryl amine hydrochloride	0.16	Concentrate	5.7	6.75	60.2
		Tailing	94.3	0.27	39.8
Fuel oil (heavy)	8.00	Composite	100.0	0.64	100.0

Another modification of the process was developed to remove coarse mica from the feed before separating the feldspar. The mineral was first agglomerated with a small amount of cationic collector and fuel oil and then tabled. A representative test is given in Table VII. The use of reagents in this manner did not have a deleterious effect in the subsequent feldspar separation. Application has been made for a patent covering the discoveries outlined above.

V. Pilot Plant Practice

The laboratory results on the Keene feldspar warranted large-scale testing under continuous operating conditions. In anticipation of a complete plant, three tables and a six-cell flotation machine were installed at Keene, N. H. The plant, under construction, was incomplete at the time of the plant tests, and it was impossible to run the crude rock continuously to make final concentrates and tailings ready for disposal. Part of the flow sheet was available, however, and the testing periods were long enough to demonstrate that agglomerate tabling and roughing and cleaning yielded products of the same grade as those made in the laboratory. With this incomplete equipment, it was impossible to determine the exact flow sheet that should be followed in the final plant.

The original treatment anticipated was to grind the rock through 20-mesh, separate it on 50-mesh, and agglomerate and table the oversize and float the undersize. In the tabling, a finished concentrate and tailing were to be made, and a middling was to be segregated and returned to the agglomerator. In the flotation, a concentrate and tailing were to be made, and a middling was to be returned to the flotation machine for re-treatment. The plans were modified later when the quartz also was thought to be a marketable product; two of the three tables therefore were added to the agglomerate tabling circuit to reclean the middling and the quartz tailing. The grinding and sizing were done in another plant, and the feed for flotation and that for agglomerate tabling were trucked separately to the bins at the pilot plant. A gyratory crusher and an air classifier were used, but it is now planned to dry-grind in a pebble mill and to classify and transport the two feeds to the pilot plant by spiral conveyers. The ground rock was fed to each circuit by a mechanical feeder 20 in. by 6 ft. in size. A cut-flight screw conveyer was used for agglomerating, and a 5- by 5-ft. conditioner was used in flotation. The primary table was full size; the cleaner tables were half size.

About 3 tons per hour of each feed (table and flotation) were treated. The amount of reagents used was about the same as described in Table I. The separations by tabling and flotation without cleaning approached those obtained in the laboratory work. The grade of concentrates and of tailing made by flotation and agglomerate tabling, respectively, was as follows:

	Flotation (assay % Al_2O_3)	Agglomerate tabling (assay % Al_2O_3)
Concentrate	20.40	20.10
Tailing	0.95	0.51

VI. Summary

In 1936 the Bureau of Mines, in coöperation with the University of Alabama and the Golding-Keene Company,

Keene, N. H., began an investigation of the concentration of feldspars by agglomerate tabling and flotation. Both potash and soda feldspars were included. A laboratory procedure was developed in which the coarse feldspar was agglomerated and tabled, and the fine feldspar was floated by lauryl amine hydrochloride and fluorine-bearing acids or salts in an acid circuit. The recoveries of feldspar were 96 to 98%, with approximately the theoretical grade of alumina. The quartz tailing was also high in quartz, with small amounts only of feldspar as impurity. By retreatment, the grade of tailing was raised to well over 99% quartz. Considerable testing was done to develop an explanation of the process. The procedure warranted further testing for commercial application, and a pilot plant was built at Keene, N. H., for this purpose. The plant testing was done before all of the equipment was installed, but the tests sufficed to confirm the laboratory work. The conditions and results approached those obtained in the laboratory. The Company is now completing the mill for commercial production.

Acknowledgment

Acknowledgments are made to Ray F. Frings, Bureau of Mines Fellow, University of Alabama; to A. Gabriel, Eastern Experiment Station, Bureau of Mines, for continued advice and for petrographic examinations of many products; and to B. H. Clemmons and John O. Dasher, Southern Experiment Station, Bureau of Mines, for assistance in running tests.

FROTH FLOTATION OF TALC ORES FROM GOUVERNEUR, NEW YORK *

By J. E. Norman, R. G. O'Meara, and F. X. Baumert

Abstract

Fibrous and foliated talc ores from Gouverneur, N. Y., were beneficiated by froth flotation. Three types of ores, *viz.*, talc-tremolite, talc-quartz, and talc-dolomite, were tested, and flotation concentrates from each were enriched in talc. Different flotation reagents were required for the ores. Pine oil was used for foliated talc and reagents of the amine type for fibrous talc. The quartz was depressed without additional reagents, but tremolite and dolomite required additional basic or acidic reagents. The talc concentrates were a better color and had a higher oil absorption index which would make them more desirable for the paint trade. A comparison of the feed and flotation products in wall-tile bodies indicates that products depleted in talc are suitable for ceramic purposes.

I. Introduction

Talc is an important industrial mineral, used both in the massive and the powdered form. Powdered or ground talc, which is also known by a variety of trade names, constitutes the bulk of the tonnage. The total production of talc in the United States in 1936 was 216,191 tons, and of this amount, 204,663 tons were sold as ground talc.[1] The ground product was employed principally in the paint, paper, roofing, rubber, and ceramic industries; the use of talc in wall tile in the last few years has markedly increased the proportion for ceramic uses.

II. Definition and Origin of Talc Ores

The mineral talc is a hydrous magnesium silicate of varying composition, and the commercial ground talc differs widely in analysis and physical properties. Talc is formed by the alteration of magnesium-bearing silicates,[2] such as tremolite, pyroxenite, and serpentine, and it is often contaminated with the parent mineral in various stages of alteration. The shape and size of the grains and properties of the parent mineral, moreover, may be retained to some extent in the altered product. The customary milling consists of grinding and classifying, and only a slight segregation of impurities is obtained through the difference in grindability of the associated minerals and in the classification.

Most of the research in the past has been concerned with the mechanical preparation rather than with the beneficiation of talc. In recent years, however, ore-dressing methods have been tested, and flotation has been applied to the foliated talc ores from Vermont.[3]

Note: The Bureau of Mines, in coöperation with the W. H. Loomis Talc Co., Gouverneur, N. Y., in 1936 began an investigation to determine the amenability of fibrous talc ores to froth flotation. The work, discussed in this Report, was done under the supervision of Oliver C. Ralston, chief engineer, Nonmetals Division. The

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[1] Carl A. Gnam, and M. A. Cornthwaite, Talc and Ground Soapstone, Bur. Mines Minerals Yearbook, p. 1329 (1937).

[2] R. B. Ladoo, Nonmetallic Minerals, Occurrence, Preparation, Utilization, 1st ed., pp. 616–28. McGraw-Hill Book Co., New York, N. Y., 1925; *Ceram. Abs.*, **4** [8] 236 (1925).

[3] J. B. Clemmer and S. R. B. Cooke, "Flotation of Vermont Talc-Magnesite Ores," *Bur. Mines Rept. of Invest.*, No. 3314, 12 pp. (1936); *Ceram. Abs.*, **16** [2] 74 (1937).

petrographic and spectrographic analyses were made by Alton Gabriel, associate chemical petrographer, and Morris Slavin, assistant metallurgist, both of the Bureau of Mines, College Park, Md.

(1) Types of Ore

The three types of ore tested from the company property near Gouverneur, N. Y., were tremolite talc ore, limey talc ore, and green talc ore. Two ores of the tremolite talc type, hanging-wall ore and footwall ore, are mined, but they differ little except in the proportion of talc and tremolite. The footwall and hanging-wall ores, which are the most important commercially, consist of fibrous talc associated with long, bladed crystals of tremolite and minor amounts of serpentine, calcite, and diopside. This ore is an intimate mixture, and in some cases the individual grains apparently consist of alternate layers of fibrous talc and tremolite. The hanging-wall ore contained about 58% talc, 42% tremolite, and a trace of serpentine, calcite, and diopside. The footwall ore sometimes contained as much as 50% talc but usually considerably less. Spectrographic analyses of both ores showed, in addition to magnesium, silicon, and calcium, minor amounts of iron, manganese, sodium, barium, strontium, aluminum, and chromium.

Talc rock from the old and new dumps of the Arnold mine was also treated by froth flotation. Both contained about 40% talc, with tremolite and serpentine as the principal impurities. More carbonate was present in these materials than in the talc ores.

The limey and green talc ores are less important, but they were included to complete the flotation study of the various ores of the deposit. The limey talc ore contained about 50% talc, both fibrous and foliated, 42% limestone, and 2% tremolite; the green talc ore contained about 60% foliated talc, 30% quartz, and 10% feldspar and tremolite.

III. Flotation Tests

The preliminary flotation tests were made on the mill products from the footwall ore, which are used either in paint or ceramic products. These mill products were massive tremolite No. 1, fibrous tremolite No. 1, and micronized fiber. The products differed slightly in the proportion of talc and in the size and shape of the grains. The micronized fiber was ground in a different manner and consisted of needlelike rather than blocky grains. The purpose of the work was to separate the products into parts more suitable for each trade.

There are no generally accepted standard specifications for marketed talc. Most talc is sold on the basis of previously satisfactory material or of plant tests. Chemical analyses are of interest, but usually physical tests pertinent to the particular trade, such as the size and shape of grain, color, slip, retention, oil-absorption index, bonding strength, melting point, and vitrification range, are more important.

(1) Evaluation of Tests

A number of different means was used to evaluate the results of the flotation tests. For a rapid estimation of the results, microscopic examination of the products, oil-absorption index, and color comparison, which are used in the paint industry, were satisfactory. Confirmation of the results was obtained by chemical and spectrographic analyses. In the case of the tremolite talc mixtures, the CaO content was considered to be indicative of the proportion of tremolite. The CO_2 content of the ores containing tremolite and calcite was determined by analysis, and the CaO equivalent to the CO_2 was deducted from the total CaO; the difference was attributed to tremolite. The tremolite was calculated on the basis of the analysis of crystals of pure tremolite from the same locality, which was SiO_2 58.04%, CaO 13.10%, MgO 24.6%, Fe_2O_3 0.30%, and ignition loss 2.26%. The suitability of the products for ceramic purposes was substantiated further by tests of wall-tile bodies.

(2) Amine-Type Reagents

The flotation tests were made in a 250- and a 1500-gram laboratory machine of the mechanical type. The smaller machine was used principally to test a large number of reagents rapidly, and the best conditions were duplicated later in the larger machine. The normal order of procedure was conditioning (mixing) of the pulp, followed by flotation of a rougher concentrate (crude concentrate), which was cleaned (refloated) until a satisfactory product was obtained. Some chemical with a depressing effect on the gangue usually was added in the conditioning and cleaning operation. The chemicals for frothing and collecting the talc were added in the conditioning just before the flotation of the rougher concentrate. The chemicals tested for floating the talc included a large number of frothers, soaps, and amines. Different flotation reagents were required for the different types of talc and various gangue minerals. Pine oil was suitable for foliated talc ores, whereas reagents of the amine type were more suitable for fibrous talc ores. The quartz was easily depressed, but tremolite and dolomite required additional acid or alkaline depressants. The pulp density maintained in the roughing (first floating) was varied from 14 to 26% solids. The thicker pulp gave a better yield, but the flotation was less selective.

(3) Other Types of Reagents

Although the amine types of reagents gave superior results on the fibrous talc-tremolite ores, the results of tests with the other types of reagents are included because the physical tests on the products indicated an improvement that should be even more marked on the products separated with the better reagents. The results of the flotation tests in Table I show the same trend of separation on all the plant products. The floated material was enriched in talc, and the products containing the most talc had the highest oil-absorption index and the best color. The value of cleaning, even with no reagents, was also demonstrated by the difference in assay of the concentrate and middling. The oil numbers were determined by the usual procedure, and the color was determined by oil rub-out tests with the feed as a standard.

Somewhat more satisfactory results on the same products are given in Table II. This test showed the same

TABLE I

PRELIMINARY FLOTATION TEST ON MILL PRODUCTS FROM FOOTWALL ORE FOR THE PAINT AND CERAMIC TRADE

Physical Properties of Similar Flotation Fractions of Different Mill Products

Reagents	Feed (lb./ton) Rougher No. 1	Rougher No. 2
Pine oil	0.18	0.35

Product	Massive tremolite No. 1 Wt. (%)	Oil No.	Color*	Tremolite (%)	Fibrous tremolite No. 1 Wt. (%)	Oil No.	Color*	Tremolite (%)	Micronized fiber Wt. (%)	Oil No.	Color*	Tremolite (%)
Rougher concentrate No. 1	41.8	38	1	37.8	43.5	38	1	47.7	11.3	63	1	29.5
Rougher concentrate No. 2	16.4	35.5	3	39.6	23.7	36	3	45.9	29.0	57	3	40.7
Rougher tailing	41.8	30.0	4	53.0	32.8	31	4	59.4	59.7	52	4	56.6
Composite (feed)	100.0	34.0	2	47.0	100.0	35	2	48.6	100.0	56.5	2	48.9

* Color determined by comparison of the four products; No. 1 the lightest and No. 4 the darkest; comparison made in oil rub-out tests.

Segregation of Talc and Tremolite and Effect of Cleaning Rougher Concentrates

Reagents	Feed (lb./ton) Rougher	Cleaner
Pine oil	0.28	No reagent

Product	Massive tremolite No. 1 Wt. (%)	Tremolite (%)	Fibrous tremolite No. 1 Wt. (%)	Tremolite (%)	Micronized fiber Wt. (%)	Tremolite (%)
Cleaner concentrate	15.4	22.2	14.0	35.0	28.9	32.0
Middling	25.0	43.6	26.2	45.5	29.4	57.6
Rougher tailing	59.6	49.8	59.8	53.7	41.7	57.8
Composite (feed)	100.0	47.0	100.0	48.6	100.0	49.0

segregation of talc and the same improvement in color and oil number as reported in Table I.

The reagents used in the previous tests were not as selective as desired, and a search for better reagents was renewed. The amine type of reagent gave a marked improvement in the flotation of the footwall and hanging-wall ores, and a number of amines were tested alone and in combination with various possible depressing agents. The previous work also indicated that the mill products were too fine for the best flotation, so the effect of the grind and particle size was studied. Wet grinding proved to be more satisfactory than dry grinding, and a −65-mesh grind liberated the minerals. Products prepared in this manner were used in the tests.

A good reagent for both the footwall and hanging-wall ores was a mixture of nitrogenous bases from recovered oil.

TABLE II

FLOTATION OF MASSIVE TREMOLITE TO SEPARATE FRACTIONS FOR THE PAINT AND CERAMIC TRADE

Reagents	Feed (lb./ton) Rougher	Cleaner
Gardinol	0.4	
Pine oil	0.5	
Sulfuric acid		2.0

Products	Wt. (%)	Oil-absorption index	Color*
Cleaner concentrate	30.2	43	1
Middling	42.2	38	2
Rougher tailing	27.6	32	4
Composite feed	100.0	37.5	3

* By comparison in rub-out test; Nos. 1 to 4 grade from best to worst.

Diamylamine gave similar results, but several other reagents were less satisfactory. The test described in Table III is representative of the results on both footwall and hanging-wall ores.

TABLE III

TYPICAL FLOTATION TEST ON TREMOLITE TALC TYPE ORE (FOOTWALL AND HANGING-WALL ORES) WITH SATISFACTORY REAGENT COMBINATION AND CONDITIONS (FEED, HANGING WALL)

Reagents	Feed (lb./ton) Conditioner	Rougher	Cleaner No. 1	Cleaner No. 2
Sodium hydroxide	2.0			
Shell nitrogenous bases	0.8		0.2	
Kerosene			0.56	
Sulfuric acid				1.50

Product	Assay (%) Wt. (%)	$CaCO_3$	Tremolite*
Cleaner concentrate	20.3	Trace	13.2
Middling No. 2	21.3	"	24.1
Middling No. 1	10.2	"	45.5
Rougher tailing	48.2	"	47.3
Composite feed	100.0	"	36.0

* The remainder was mainly talc.

By the method to be described, 32.5% of the hanging-wall feed was recovered with a tremolite content of 13.0%.

Because it was found that the amine type of reagent was selective for talc, a series of these compounds was tested as talc collectors. The talc rock from the old dump, the Arnold mine, was used in all of these tests. Two tests were run with each reagent, *viz.*, (1) in which 2.0 lb. per ton of H_2SO_4 was used as a conditioner, and (2) in which 2.0 lb. per ton of NaOH was used as a conditioner. The p_H of the acid circuit ranged from 6.7 to 7.1, and the alkaline circuit ranged from 11.1 to 11.4. The presence of

carbonates prevented further lowering of p_H by acid. Tests using less alkali than 2.0 lb. per ton were less satisfactory than when this amount was used.

The collecting power of the reagents used is classified in Table IV. Their behavior is designated as (1) none; (2) weak, or those that tend to float only platey talc; (3) powerful, or those that tend to float platey and fibrous talc; and (4) very powerful, or those having a marked collecting power for gangue as well as talc.

Considering both purity of the concentrate and recovery, the best reagents used were di-*n*-butylamine (alk.), tri-*n*-butylamine (alk.), diamylamine (alk.), triamylamine (alk.), and α-picoline. Among the weaker collectors that gave the purest concentrate were triethanolamine (acid), monopropanolamine (acid), phthalimide (acid and alk.), aniline (alk.), pyrrole (alk.), monoethylamine (alk.), diethylaminoethanol (acid), morpholine (acid and alk.), and pyridine (alk.).

Although several reagents were found to be selective collectors of talc, none gave a very clean talc concentrate. Because of this, several possible dispersants and combinations of dispersants were used with di-*n*-butylamine as a collector. The purpose of these was to clean the surface of the gangue minerals of talc.

The compounds were as follows:

Sodium zincate
Sodium aluminate
Daxad 11
Sulfuric acid
Sodium fluoride and sodium fluosilicate
Sodium hydroxide and sodium carbonate
Potassium ferricyanide
Aluminum sulfate
Sodium hydroxide, sodium carbonate, and sodium silicate
Sodium hydroxide and sodium silicate
Sodium carbonate and sodium silicate
Sodium carbonate
Sodium hydroxide

Of the compounds used, sodium carbonate alone gave the purest talc concentrate. It was found that wet grinding with sodium carbonate (2 lb. per ton), allowing the pulp to settle thirty minutes, decanting and discarding the suspended matter, and froth-floating the granular sediment gave the best concentrate. Rigorous cleaning and regrinding with 1.0 lb. per ton of Na_2CO_3 was beneficial.

To sum up, the best method of concentrating hanging-wall, footwall, and dump talc rock is (1) to wet grind −10-mesh rock to pass 65-mesh with 2.0 lb. per ton of Na_2CO_3, (2) deslime after 30 minutes settling, (3) rough with 0.75 lb. per ton of di-*n*-butylamine, (4) clean the rougher concentrate twice with 0.15 lb. per ton of di-*n*-butylamine, (5) regrind for a short period with 1.0 lb. per ton of Na_2CO_3, and (6) reclean with 0.15 lb. per ton of di-*n*-butylamine.

By the foregoing method, the following results were obtained with different feeds:

Feed	Feed recovered as concentrate (%)	Tremolite in concentrate (%)
Hanging wall	32.5	13.0
Footwall	14.0	21.4
New dump	30.6	9.9, 0.73% $CaCO_3$
Old dump	32.8	12.2

The green talc ore was easily floated with pine oil alone. One cleaning of the rougher concentrate without a depressant gave a talc concentrate of 90% grade, representing a yield of 42.2% of the feed.

The limey talc ore was more difficult to treat. Although the talc floated quite readily, the limestone was difficult to depress. The best procedure was to grind through 100-mesh and float as follows:

	Feed (lb./ton)		
Reagents	Rougher	Cleaner No. 1	Cleaner No. 2
Soda ash	1.0	0.5	
Sodium silicate	0.5	0.2	
Pine oil	0.1		0.10
Kerosene	1.0		

This treatment gave a cleaner concentrate, which represented a recovery of 22% and assayed 10.2% $CaCO_3$, the remainder being mainly talc.

IV. Wall-Tile Body Tests

Having established the fact that the talc could be floated from the tremolite-talc mill products and that the flotation concentrates enriched in talc were more satisfactory for the paint trade, the next step was to test both these products and those depleted in talc for use in the ceramic trade in wall tile. The massive tremolite was considered to be representative of the ore and was selected for the test. The feed and three flotation products (shown in Table II) and the concentrate from the limey talc ore (discussed in the flotation of the limey talc ore) were included in the tests. The products are analyzed in Table V. The different grades of talc used in a typical wall-tile body are indicated in Table VII. All of the ingredients except the talcose material were the same.

Each body was made into a slip, screened through 120-mesh lawn, dewatered, and dried to constant weight. Ten per cent of tempering water was added, and the material was crushed and screened through 20-mesh. The body was then dry-pressed into specimens, $^3/_8$ by $2^1/_8$ by $4^1/_4$ inches. The test pieces were given a biscuit-fire at cone 2, and then were glazed with a standard glaze and fired to determine glaze warpage and crazing. The results of the test are given in Table VI.

Judging from the lower absorption values, bodies Nos. 2 and 3 were slightly more dense; bodies Nos. 3 and 5, containing talcs of higher lime content, gave the poorest colors but otherwise were satisfactory.

The slight variation in the physical properties of the bodies showed that a wide variation in the talc content was permissible and suggested that tremolite alone might have possibilities. This indicates that a high-grade talc product could be separated for other purposes and the remaining products could still be used, alone or blended with the original feed, as regular stock for wall tile. No waste therefore need be entailed in beneficiating these ores by flotation. Another interesting point was that limey talc could be freed from enough of the dolomite or limestone by flotation that the talc concentrates were also suitable for wall tile.

V. Summary

The results show that the three types of ore from the W. H. Loomis Talc Corp., Gouverneur, N. Y., may be improved by froth flotation. The ores differed in the

TABLE IV

COLLECTING POWER OF REAGENTS FOR TALC

None	Weak	Powerful	Very powerful
Methylamine (acid)	Tetramethylammoniumhydroxide	Pine oil	Triamylamine (acid)
Monoethanolamine	Methylamine (alk.)	Acetyldiethylamine	*n*-Heptylamine
Diethanolamine	Dimethylamine	Triethylamine	Heptamide (acid)
Ethylene diamine	Monoethylamine	Diethylaminoethanol (alk.)	2-Amino-*n*-octane
1,3-Diaminoisopropanol	Diethylamine	Acetoacetanilid (acid)	Dicyclohexylamine (acid)
Guanidine nitrate (acid)	Triethylamine	Di-*n*-propylamine	DuPont "QB" (acid)
4-Pyridylpyridinium chloride	Tetraethylammoniumhydroxide	Tri-*n*-propylamine	DuPont trimethyl-cetylammonium - bromide
Dipicrylamine	Triethanolamine	*N*-butylamine	DuPont 243 (acid)
5-Amino-salicylic acid	Diethylaminoethanol (acid)	Commercial pyridine (Barrett)	
Benzidine	Morpholine	Diamylamine	
DuPont "Q" (alk.)	Acetoacetanilid (alk.)	Di-*n*-butylamine	
	Pyridine	Cyclohexylamine	
	Monopropanolamine	Dipropanolamine (alk.)	
	Dipropanolamine	Tripropanolamine	
	Guanidine nitrate (alk.)	Tri-*n*-butylamine	
	Tetrone "B" (very weak)	Monoamylamine	
	Alba 211 (alk.)	Triamylamine (alk.)	
	Phthalimide	Heptaldoxime	
	Dipicrylamine (alk.)	*n*-Caproamide	
	Aniline	*α*-Picoline	
	Pyrrole	Dicyclohexylamine (alk.)	
	DuPont "QB" (alk.)	Quinoline	
	DuPont "Q" (acid)	Alba 211 (acid)	
		o-Toluidine	
		Dibenzylamine	
		o-Tolyl urea	
		o-Tolyl hydrazine	
		Isoquinoline	
		DuPont 243 (alk.)	

TABLE V

ANALYSES OF TALC PRODUCTS USED IN WALL-TILE BODY

Tremolite sample No.	Sample	$CaCO_3$	Assay (%) Tremolite	Talc	Ignition loss	Fe_2O_3	MnO
	Massive tremolite No. 1						
(1)	Cleaner concentrate (high talc)	1.22	30.00	68.78	6.42	0.37	0.34
(2)	Middling	1.29	39.45	59.26	6.45	0.46	0.40
(3)	Tailing (high tremolite)	1.15	48.50	50.35	6.06	0.38	0.43
(4)	Feed	1.22	41.75	57.03	5.75		0.36
	Limey talc ore						
(5)	Cleaner concentrate	9.45	19.90	70.65	8.40	0.66	0.15

TABLE VI

WALL-TILE BODY TESTS MADE WITH DIFFERENT TALC FRACTIONS

Physical properties	Body No. (1)	(2)	(3)	(4)	(5)
Fired shrinkage (%)	4.07	4.91	4.05	4.18	4.25
Absorption (%)	16.9	16.3	16.4	17.2	16.9
Moisture expansion (%)	0.033	0.026	0.031	0.029	0.031
Transverse strength (lb./in.^{2})	2955	3020	2715	2920	3165
Glaze warpage	+0.0057	+0.0051	+0.0041	+0.0049	+0.0037
Quench test 100°C diff.	O. K.	O. K.	O. K.	O. K.	O. K.
Autoclave 150 lb.	O. K.	O. K.	O. K.	O. K.	O. K.
Test (5 tests) 200 lb.	O. K.	O. K.	O. K.	O. K.	O. K.
Color	1	3	4	2	5

type of talc, foliated and fibrous, and in the proportion and kind of impurities, calcite, tremolite, serpentine, diopside, and quartz, and each represented a different problem in flotation. The ores containing fibrous talc and those containing tremolite and calcite were difficult to separate, whereas those containing foliated talc and quartz were easy to float. Pine oil was suitable for foliated talc, but reagents of the amine type were more suitable for fibrous talc. Quartz was depressed without an additional reagent, but tremolite and dolomite required additional basic or acid reagents, or both, in different cleanings. Amines, such as di-*n*-butylamine and diamylamine, were the most

TABLE VII*

COMPOSITION OF WALL-TILE BODIES

Ingredients	Body No. (1)	(2)	(3)	(4)	(5)
	(wt. of ingredients (%))				
Bell's Dresden ball clay	10	10	10	10	10
Corley No. 3 clay	12	12	12	12	12
Putnam Fla. kaolin	15	15	15	15	15
Pyrophyllite	23	23	23	23	23
Tremolite No. 1	40				
Tremolite No. 2		40			
Tremolite No. 3			40		
Tremolite No. 4				40	
Tremolite No. 5					40

satisfactory on the fibrous talc-tremolite ores. The results indicate that a product high in talc content may be separated from each of the ores and, in the case of the talc-tremolite ores, nothing need be wasted through the beneficiation. The tailing, enriched in tremolite, is suitable, as is, or blended with the feed, for wall tile.

* Weight of Connecticut feldspar as the addition material is 5%.

UNITED STATES BUREAU OF MINES
EASTERN EXPERIMENT STATION
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A SMALL ELECTRIC ARC FURNACE FOR MELTING AND POURING GLASSES AND CORROSIVE SLAGS*

BY J. A. TAYLOR

ABSTRACT

An electric arc furnace was built to replace the gas furnace (described in *Jour. Amer. Ceram. Soc.*, **19** [2] 39–44 (1936)). This furnace is quick and melts difficult substances with ease. The advantages of the radiation type of melting and the ease with which test pieces may be made in a pure state are discussed and described.

A new method for studying the flow characteristics of glasses and slags at elevated temperatures has been described.[1]

A diagrammatic sketch of the furnace with the essential details is shown in Fig. 1. The furnace is operated on 110 volts a.c. with a fixed resistance of 3.5 ohms in series. The

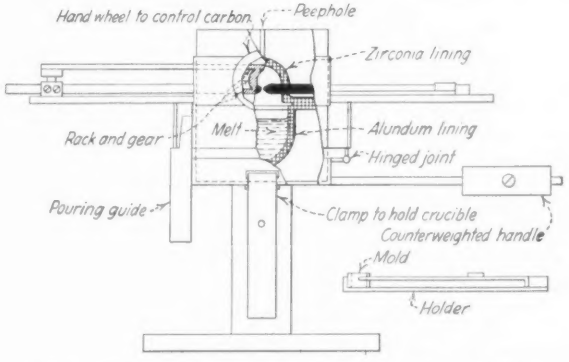

FIG. 1.—Arc furnace for melting glass and slags.

power requirements are 2.0 to 2.5 kw., depending upon the length of arc maintained in the furnace. The carbon-feeding mechanism is hand-operated, but it moves both carbons into the furnace at the same time. The radiation dome of the furnace is cut from a high-grade, lightweight fire brick and is lined with zirconia. The crucibles are made from the same lightweight brick used in the furnace, but they are lined with Alundum cement. Two crucibles may be obtained from one standard brick. It is recommended that a new crucible be used every time the melt is changed.

Heating from above with radiant energy permits the crucible to be packed to a maximum without danger of overflow during the melting. Melting begins on top so that gases may escape downward and out through the bottom and sides of the porous crucible. Gases which escape from the melt leave from the fluid surface without any violent ebullition. Melting takes place chiefly in the center of the crucible where the heat is concentrated, and if the crucible well is considerably larger than the radiation dome of the furnace, only sintering takes place near the edge of the crucible. The net result of this type of melting process is that a pool of molten slag is formed in the center of a shell of sintered material which has the same composition as the melt.

The pouring of molten material from the crucible is simple because the crucible holder is hinged and is equipped with a counterbalanced handle to move the crucible downward to the vertical position. The melt is poured into a small round steel mold, and it is equipped with a handle and a holder; the mold consists of a $\frac{1}{2}$-in. hole drilled into a ring, $\frac{3}{4}$ by $\frac{1}{2}$ in. (see Fig. 1). The red-hot billet, now ready for annealing, is tapped out of the mold into a container filled with Sil-O-Cel for slow cooling. The billet should be completely covered with the loose particles and allowed to cool for a period of 15 minutes to one-half hour.

Any number of tests may be run with the test piece prepared in this manner. Flow characteristics, contact angles, and relative viscosities may be measured as described.[1] Tests, such as density, index of refraction, light absorption, breaking strength, and the effect of various heat treatments, may also be studied.

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[1] E. P. Barrett, and J. A. Taylor, "New Method for Studying the Flow Characteristics of Glasses and Slags at Elevated Temperatures," *Jour. Amer. Ceram. Soc.*, **19** [2] 39–44 (1936).

ACTIVITIES OF THE SOCIETY

WHY ANNUAL MEETING REGISTRATION FEES

After years of experience, study, and trials of various schemes, the Board of Trustees of The American Ceramic Society has adopted the policy of financing Annual Meetings wholly from registration fees.

The cost of building and operating the Annual Meeting programs has always been financed by The Society, partly by registration fees (in earlier years, by exhibits) and partly from its general funds. The cost of entertainment at the Meetings for several years was paid by the local committees.

From 1921 to 1928, inclusive, the local committees raised large sums of money by subscription and spent it on elaborate entertainment. The subscribers often disapproved of such expenditures, causing The Society subsequently to lose good will and financial support.

In 1929, the Chicago Local Committee put on an exhibit, the profits from which were spent at their discretion, and enough was turned over to The Society to cover all of the organizing and operating expenses with $143.04 to spare. Exhibits and fees at Toronto paid all but $798.44 of The Society's operating expenses, but the Local Committee spent over $3000 on entertainment, all of which was raised by subscription. Profits from exhibits plus registration fees at Pittsburgh in 1933 covered The Society's operating expenses, but the Local Committee raised and expended over $1500. In Cincinnati, the registration fees nearly covered The Society's operating expenses, but the Local Committee spent over $1500 raised by subscription.

Beginning with the 1936 Meeting, The Society has not allowed the local committees to collect money by subscriptions from local concerns and individuals, allowance for entertainment being provided by The Society. In New York in 1937, the Local Committee spent $798.03; in 1938 in New Orleans, the entertaining cost was $409.50, and in Chicago in 1939 it was $1000.

For the 1940 Meeting in Toronto, the Local Committee will not be permitted to spend more than $1000, all of which must come from registration fees.

Meetings Must Be Financed

The Society would lose its status with the several federal and state taxing agencies as strictly a scientific, technical, and educational organization should it finance any portion of its Meeting expenses by holding commercial exhibits.

To finance the Meetings out of the general funds would mean (1) making all members of The Society pay for the advantages enjoyed only by those who attend, (2) making Meeting privileges available without cost to a lot of persons who are not members, and (3) using the money for Meetings that presumably is to be expended only for publications and for operating The Society.

In 19 years, the net loss totals $15,155.03, or $797.63 per Meeting.

Meeting together, working together, and communing together make for personal and industrial progress. These are reasons why Meetings are held. The research reports obtained would not alone justify the holding of Meetings, for these could be obtained in other ways with much less effort and expense.

Until commercial exhibits are again allowed under federal and state tax regulations without having The Society classified as commercial and as such liable for the several income and wage taxes, the most generally satisfactory and certainly the most practical scheme is to finance the Meetings, exclusively by registration fees, *viz.*, $5.00 for delegates, $1.50 for students, and $1.00 for wives. (These have proved to be the fees needed to cover the Meeting expenses.)

The Profit and Loss Statements for several Meetings are as follows:

Date	Place	Profit	Loss
1921	Columbus		$1667.27
1922	St. Louis		1301.26
1923	Pittsburgh		1455.17
1924	Atlantic City		1522.40
1925	Columbus		2470.45
1926	Atlanta		1410.28
1927	Detroit		2078.49
1928	Atlantic City		1276.83
1929	Chicago	$143.04	
1930	Toronto		798.44
1931	Cleveland	666.90	
1932	Washington, D. C.		873.24
1933	Pittsburgh	125.21	
1934	Cincinnati		160.00
1935	Buffalo	460.16	
1936	Columbus		365.92
1937	New York		439.03
1938	New Orleans		1286.00
1939	Chicago	554.44	
		$1949.75	$17104.78

Reactions Expressed

The foregoing statement was mimeographed and sent to officers and committeemen of the Divisions. Some phoned approvals and several wrote their approval; none has expressed disapproval. The following comments are illustrative of the answers received.

(1) "With reference to your communication of June 23 on the subject of Annual Meeting registration fees, I am with you 100%. It simply gets down to the fundamental that no self-respecting adult will make a habit continuously of thumbing free rides or of chiseling free data. For members or nonmembers to gather in all the values of a costly Meeting without assuming their proper share of the expense in my opinion is an unadulterated cheap procedure. Let the Meetings be self-supporting and let local committees be free from the need of underwriting entertainment expense unless there is available for such purpose some local convention entertainment fund. Under such a circumstance it would be silly, of course, not to give an American Ceramic Society Meeting the same support as is generally offered to other conventions in the same city.

"It has been my opinion for a long time that a national American Ceramic Society Meeting, Division meetings, or any other similar group should have a registration fee. I further believe that a registration fee for nonmembers at any meeting should be higher by a considerable margin than that for members in order to constitute some inducement for such people to join The Society rather than to sit by economically selecting the high spots that they are interested in and passing up the important responsibility of continuous support."

(2) "After reading your memorandum I agree absolutely that a registration fee of $5.00 for delegates, $1.50 for students, and $1.00 for wives is not only necessary but is reasonable. Obviously the Annual Meetings must be financed, and registration fees are a sensible way to solve the problem.

"The value of the Meetings to The Society individually is incalculable, and for this alone the fee could be called extremely moderate. It is not a good thing to have local committees collect local subscriptions for the entertainment at these Meetings, and it is not good that The Society should be called upon to use money for entertainment.

Such money could be expended on additional publications and other work essential to the successful operation of the Society."

(3) "I am in accord with the program outlined in your letter of June 23, 1939. Charging registration fees is certainly the fair way of financing these meetings, and the article you have prepared explains the situation satisfactorily.

"It would seem obviously advantageous to keep these fees as low as possible and to make them higher for nonmembers than for members; this is no more than fair to the members. I know many who attend who do not belong to The Society and continue to do so year after year.

"Under such a plan it might be wise to allow corporation members to designate certain employees as their delegates, even though they are nonmembers."

(4) "I can not see anything exceptional about the $5.00 cost. It certainly is better to have registration fees which cover the expense of the Meetings rather than local solicitations to burden and embarrass the local committees and the firms in the meeting area."

(5) "Anyone who has had to help in getting subscriptions to finance these Meetings will approve the moderate registration fees that have been adopted. It seems to me to be a sound and sane custom."

(6) "I feel strongly that a suitable registration charge is the logical way to defray the expenses of these meetings. I do not think it should be at all necessary to encroach upon the funds of The Society for this purpose. The amount of $5.00 is not great enough to affect the attendance, particularly when it is recalled that the majority of those attending have their expenses defrayed.

"You might be interested in knowing that the registration fee for the May, 1939, meeting of the American Institute of Chemical Engineers, held in Akron, was $8.00, which included the banquet."

"I am frank to admit I have sometimes wondered why the registration fee was seemingly so high—more so than formerly—and my feeling is that the information you have given should convince any reasonable person that the fees are justified and that you should hear no further criticism."

FORTY-SECOND ANNUAL MEETING THE AMERICAN CERAMIC SOCIETY

April 7–13, 1940

Toronto, Canada—Royal York Hotel

NEW MEMBERS

Personal

DICKENS, H. A., 29 Cromwell St., Collingwood, Melbourne, Australia; manager, Nilsen Cromie Pottery, Ltd.

HUBLER, WILLIAM G., American Nepheline Corp., Rochester, N. Y.; managing director.

DE MENDOZA, JOSE HURTADO, Escuela Tecnica Industrial E.J.V., Rancho Boyeros, Habana, Cuba; professor of technology.

JEWART, CHARLES N., 79 Lake Ave., Blasdell, N. Y., ceramic engineer, Bethlehem Steel Corp.

SHEPARD, ANNA O., Route 1, Box 173, Boulder, Colo.; archaeological ceramic technologist, Carnegie Institute of Washington.

TREMBLAY, RAYMOND J., Bethlehem Steel Co., Seattle, Wash.; combustion engineer.

WALKER, HERBERT M., Bailey-Walker China Co., Bedford, Ohio; vice-president.

Student

University of Illinois: WILLIAM D. FORD AND CARL F. SCHAEFER.

New York State College of Ceramics: WILLIS G. LAWRENCE.

Ohio State University: WILLIAM D. SPORE, LLOYD R. WHITTINGTON, AND WILLIAM F. WINEMILLER.

Membership Workers' Record

Personal			
A. I. Andrews	1	G. L. Rogers	1
Angel Castillo	1	Office	4
Student			
A. I. Andrews	5	Office	1
		Grand Total	**13**

ROSTER CHANGES DURING JULY*

Personal

BLUE JOHN T. Commercial Decal Products, Inc., East Liverpool, Ohio (incorrectly listed in July *Bulletin*)

COX, PAUL E., 307 Audubon St., New Orleans, La. (Ames, Iowa)

DAMMANN, ARTHUR, 644 W. Surf St., Apt. 410, Chicago, Ill. (Seattle, Wash.)

DODD, CHARLES M., Dept. of Ceramic Engineering, Iowa State College, Ames, Iowa (Rolla, Mo.)

HOTTINGER, A. F., Ocean Springs, Miss. (Green Bay, Wis.)

HUMMEL, ROY, 425 Union Court, Fostoria, Ohio (Toledo, Ohio)

MCCANN, SIDNEY W., Pfaudler Werke A. G., Schwetzingen, Baden, Germany (Leven Fife, Scotland)

MINTON, LEWIS G., Seville, Ohio (Atlanta, Ga.)

MONG, LEWIS, E., 8506 Loughborough Place, Chevy Chase, Md. (Washington, D. C.)

MOORE, JOHN G., R. F. D. 2, Flat Rock, Ill. (Fort du Pont, Del.)

RANKIN, JAMES J., Box 97, Monaca, Pa. (Josephtown, Pa.)

RICKER, RICHARD W., Technical Dept., Libbey-Owens-Ford Glass Co., 1701 East Broadway, Toledo, Ohio (Parkersburg, W. Va.)

SARANDRIA, JOSEPH A., 1394 McKinley Parkway, Lackawanna, N. Y. (Buffalo, N. Y.)

STAFFORD, W. L., 2953 Neil Ave., Apt. 281-A, Columbus, Ohio (Manville, N. J.)

THOMPSON, NOEL M., 721 Shady Lane, Station 16, Pittsburgh, Pa. (Springdale, Pa.)

WHEELER, D. D., 501 W. 7th St., Plainfield, N. J. (East Orange, N. J.)

ZOLLER, MILES M., 315 Temple Bar Bldg., Cincinnati, Ohio (Cleveland, Ohio)

*Address in parentheses is the former address.

SELL AMERICANS

PAID MEMBERSHIP RECORD

Date of Record	Members Paid		Deferred	Subscriptions	Monthly Sales	Total Circulation
	Personal	Corporation				
December 20, 1936	1452	196				
December 22, 1937	1713	220	12	523	220	2688
December 19, 1938	1815	222	26	589	220	2872
January 21, 1939	1792	220	26	610	220	2868
February 18, 1939	1795	225	25	620	220	2885
March 30, 1939	1808	229	23	648	220	2929
April 18, 1939	1641	226	58	596	220	2741
May 20, 1939	1710	231	43	611	220	2815
June 16, 1939	1739	232	42	617	220	2850
July 17, 1939	1753	233	39	626	220	2871

Plant-to-Profit Clubs

Plant-to-Profit Clubs (see *The Country Home Magazine*, June, 1939) have changed 42,000 families and 200,000 persons from the ill-clad and ill-fed, hopeless, shiftless, sharecroppers to "heads-up" prosperous people, many of them now owning farms. This has been accomplished without federal or state aid. These people were sold on a system of self-help. Plant-to-Prosper farmers in nine of the erstwhile "one-crop cotton states" produced more than $20,000,000 in new crops.

Sell Americans the idea that American ceramic ware is "tops."

Sell American ceramists the fact that they "Plant to Profit" in ceramic knowledge by coöperating with the "up-and-going" ceramists through membership in

The American Ceramic Society

Sell American corporations on the fact that by a minimum investment of a $25.00 Corporation Membership in this Society they will profit as have the merchants, bankers, newspaper publishers, and industrialists of the South, who have derived large returns from their promotion of the "Plant-to-Prosper" clubs.

AUTUMN MEETING PROGRAMS

GLASS DIVISION ELEVENTH AUTUMN MEETING

Skytop Lodge, Skytop, Pa., September 8 to 10

Friday, September 8

9:30 A.M. SYMPOSIUM ON GLASS DEFECTS

1. Some Inhomogeneities in Opaque (Fluorine and Sulphide) Glasses

BY N. J. KREIDL, Dunkirk Glass Works, Dunkirk, N. Y.

2. Staining of Glass, Some Possibilities in the Study of Inhomogeneities

BY W. WEYL, Department of Ceramics, Pennsylvania State College, State College, Pa., AND J. C. TURNBULL, Preston Laboratory, Butler, Pa.

3. Homogeneity of Optical Glass

BY W. FRASER AND MURRAY SCOTT, Bausch & Lomb Optical Co., Rochester, N. Y.

4. Glass Stones

BY C. L. THOMPSON, Harbison-Walker Refractories Co., Pittsburgh, Pa.

5. Discussion of papers

11:00 A.M.

6. Progress Report on the Activities of A.S.T.M. Committee C-14 on Glass and Glass Products

BY LOUIS NAVIAS, General Electric Co., Schenectady, N. Y.

3:00 P.M.

7. Round-Table Discussion on Chemical Analysis

LED BY G. E. F. LUNDELL, National Bureau of Standards, Washington, D. C.

Saturday, September 9

9:30 A.M. SYMPOSIUM ON CHEMICAL DURABILITY OF GLASS

8. p_H Determinations as a Measure of Durability

BY S. R. SCHOLES, Department of Glass Technology, New York State College of Ceramics, Alfred, N. Y.

9. Resistance of Glass Containers to Alcoholic Solutions

BY FRANK R. BACON AND O. G. BURCH, Owens-Illinois Glass Co., Toledo, Ohio

10. Relation Between Storage and Accelerated Chemical Durability Tests for Several Glass Compositions

BY A. K. LYLE, Hartford-Empire Co., Hartford, Conn.

11. Some Observations on Methods of Analysis Applicable to Solutions Obtained in Tests for Chemical Durability of Glass

BY E. H. HAMILTON, DONALD HUBBARD, AND A. N. FINN, National Bureau of Standards, Washington, D. C.

12. Chemical Durability Requirements of Pharmaceutical Containers

BY E. B. CARTER, Abbott Laboratories, North Chicago, Ill.

W. Ronald Lester, Vice-Chairman, Glass Division

Social Activities

2:30 P.M.

GOLF

7:00 P.M.

INFORMAL BANQUET AND DANCE

Ladies' Entertainment

Friday afternoon, September 8: Bridge tea
Friday night: Movies
Saturday morning, September 9: Putting contest
Saturday afternoon: Bowling on the Green
Saturday night: Informal banquet and dance

NOTE: Hotel reservation blanks have been sent to the Glass Division members. If blank has not been received, reservation details may be obtained by writing Thornton Raney, Skytop Lodge, Skytop, Pa.

Hotel Rates

Twinbedded room (running water), $8.00 per day; single room (running water), $9.00 per day.
Twinbedded room (with bath) $9.00 per day; single room (with bath) $10.50 per day.

Division Officers

The officers of the Glass Division are as follows: *Chairman*, N. W. TAYLOR, Pennsylvania State College, State College, Pa.; *Vice-Chairman*, W. R. LESTER, Maryland Glass Corp., Baltimore, Md.; *Secretary*, S. R. SCHOLES, N. Y. State College of Ceramics, Alfred, N. Y.; *Papers and Program Committee*: *Chairman*, W. R. LESTER; A. K. LYLE, Hartford-Empire Co., Hartford, Conn.

REFRACTORIES DIVISION AUTUMN MEETING

Oakland Beach Hotel, Conneaut Lake, Pa.,
September 8 and 9

The Refractories Division of The American Ceramic Society is holding its Autumn Meeting on September 8 and 9 at Oakland Beach Hotel, Conneaut Lake, Pa.

Committee C-8 of the American Society for Testing Materials will meet at the same place on September 7, and those in attendance will stay over for the Refractories Division Meeting.

Program
Friday, September 8

9:30 A.M.–1:00 P.M. (W.S.T.)

WELCOME BY S. F. WALTON, *Division Chairman*

SUBJECT: SPECIAL REFRACTORIES USED IN THE NONFERROUS INDUSTRIES

1. Nonferrous Refractories.

BY GRANT S. DIAMOND, Electro Refractories & Alloys Corp., Buffalo, N. Y.

2. Refractories Used in Wyatt Induction Furnaces Melting Copper, Brass, Nickel-Silver, and Other Alloys.

BY SEAVER H. BOOTH, American Brass Co., Ansonia, Conn.

3. Observations on Refractories Used in Melting and Holding Furnaces for Aluminum.

BY H. O. BURROWS, Aluminum Co. of America, Cleveland, Ohio.

4. High-Temperature Chemical Reactions Viewed by Moving Picture Camera (2 films).

Research Department, Carborundum Co., Niagara Falls, N. Y.

1:00–2:00 P.M. LUNCH, MAIN DINING ROOM

AFTERNOON: Golf, swimming, boating, tennis

6:00–8:30 P.M. DINNER, MAIN DINING ROOM

10:00 P.M. CORN ROAST—DANCING

Saturday, September 9

9:00 A.M.–12:30 P.M. (E.S.T.)

SUBJECT: SPECIAL REFRACTORIES USED IN THE STEEL INDUSTRY

5. Refractories Used in High-Frequency Electric Melting of Steel and Alloys.

BY B. W. MAGALIS, Babcock & Wilcox Co., Barberton, Ohio.

6. Refractory Life in Electric-Arc Melting of Steel and Alloys.

BY A. V. LEUN, Bethlehem Steel Co., Bethlehem, Pa.

7. Correlation of Physical and Chemical Properties of Stopper-Heads with Open-Hearth Service.

BY JOSEPH A. SARANDRIA, Electro Refractories & Alloys Corp., Buffalo, N. Y.

12:30 P.M.–1:30 P.M. LUNCH, MAIN DINING ROOM

Social Activities

AFTERNOON: Kicker's Handicap Golf Tournament in charge of Roger W. Rowland, Newcastle Refractories Co., New Castle, Pa.

Ladies' Bridge Tournament in charge of Mrs. H. E. White, *Chairman, Ladies Committee*

6:00 DINNER, MAIN DINING ROOM

8:30 P.M. DISTRIBUTION OF PRIZES—LOBBY

Location

Special entertainment for the Ladies both Friday and Saturday in charge of committee headed by Mrs. H. E. White.

Conneaut Lake is in western Pennsylvania, south of Erie, and near Meadville. It is the only natural lake of any size in the entire State. The Oakland Beach Hotel is on the eastern shore on Route 18. It is within an easy day's drive of most of the large industrial areas.

Meadville, Pa., is ten miles east of Conneaut Lake on the main line of the Erie Railroad. The hotel will meet trains from New York, Chicago, and Cleveland on notification. The Pennsylvania Railroad makes connections either from Pittsburgh or Erie for Linesville, Pa. Linesville is six miles west of Conneaut Lake. Hotel transportation facilities will be available from this point also.

Hotel Rates

Hotel rates, including guest card for golf and all other facilities, are as follows: American Plan, $8.00 single per day, $14.00 per couple per day.

The entire hotel is reserved for the Autumn Meeting of the Refractories Division, and when making reservations mention of attendance at the meeting is necessary.

Registration will be Thursday evening and Friday and Saturday mornings. Registration fee, $1.00.

Division Officers

The officers of the Refractories Division are as follows: *Trustee,* C. E. Bales, Ironton Fire Brick Co.; *Chairman,* S. F. Walton, Exolon Co.; *Vice-Chairman,* J. B. Austin, U. S. Steel Corp.; *Secretary,* Gilbert Soler, Timken Steel & Tube Co.; *Program Chairman,* R. S. Bradley, A. P. Green Firebrick Co.; and *Vice-Chairman, Program Committee,* G. S. Diamond, Electro Refractories & Alloys Corp.

COMMITTEE ON HONORARY MEMBERSHIP OF THE FELLOWS

ALEXANDER SILVERMAN: Dept. of Chemistry, Univ. of Pittsburgh, Pittsburgh, Pa.

M. E. HOLMES: New York State College of Ceramics, Alfred, N. Y.

LOUIS NAVIAS: General Electric Co., Schenectady, N. Y.

EDWARD SCHRAMM: Onondaga Pottery Co., Syracuse, N. Y.

WHITE WARES AND MATERIALS AND EQUIPMENT DIVISIONS JOINT MEETING

Summit Hotel, Uniontown, Fayette County, Pa.,
September 15 and 16

The members of the White Wares and Materials and Equipment Divisions will meet at the Summit Hotel, Uniontown, Fayette County, Pa., on September 15 and 16. Technical sessions will be held from 9:30 A.M. to 12:30 P.M. on Friday and Saturday.

The afternoons and evenings will be given over to golf, swimming, tennis, and dancing.

Although the program has not yet been completely arranged, the following titles will be presented:

1. The Overstrom Mud Screen as Applied to Ceramic Slips

By G. W. JARMAN, JR., President, Separations Engineering Corp., New York, N. Y.

2. Improved Grinding Methods

By N. E. BROWN, Sales Engineer, The Stevenson Co., Wellsville, Ohio

3. Some Properties of Casting Slips

By G. A. LOOMIS, Engineering Experiment Station, Ohio State University, Columbus, Ohio

4. Discussion of a Dry-Mixing Installation

By E. T. MONTGOMERY, Smith & Stone, Ltd., Georgetown, Ontario, Canada.

5. Symposium: Thermal-Shock Test Methods

(*a*) Fundamentals of Thermal-Shock Resistance.
By F. P. HALL, Pass & Seymour, Inc., Syracuse, N. Y.

(*b*) Miscellaneous talks by six or more plant men relating their experiences with thermal shock.

(*c*) General discussion.

6. Symposium: Use of Ceramic Raw Materials in Whiteware Bodies and Glazes

(*a*) Talc
(*b*) Beryl
(*c*) Zoisite
(*d*) Miscellaneous materials

A dinner meeting will be held on Friday evening. The speaker for this occasion will be announced later.

There will be a registration fee of $1.00.

Hotel Rates

American plan: $6.50 per day (double).

Division Officers

The officers of the White Wares Division are Karl Schwartzwalder, *Chairman;* Harry Thiemecke, *Secretary;* and Ralston Russell, Jr., *Chairman, Papers and Program Committee.*

The officers of the Materials and Equipment Division are William R. Malkin, *Chairman;* W. H. Emerson, *Secretary;* F. E. Finch, *Chairman, Papers and Program Committee;* and S. S. Cole, *Chairman, Papers and Program Committee,* Autumn Meeting.

William R. Malkin, *Chairman,* Materials and Equipment Division

Karl Schwartzwalder, Chairman, White Wares Division

OUR MEMBERS ON THE WEST COAST

These Society Members were among those who worked hard on plans for the General Meeting of the American Ceramic Society, Golden Gate Exposition, in San Francisco this month.

A. S. Adcock, *Chairman*, Northern California Section

Atholl McBean, Speaker at Dinner

T. K. Cleveland, *Chairman*, Program Committee

C. W Kraft, *Chairman*, Publicity Committee

THE INSTITUTE OF CERAMIC ENGINEERS

Executive Committee
President: J. L. CARRUTHERS, Ohio State Univ., Columbus, Ohio.
Vice-President: H. G. WOLFRAM, Porcelain Enamel & Mfg. Co., Baltimore, Md.
Secretary: S. J. MCDOWELL, General Ceramics Co., Keasbey, N. J.
Trustee Representative: R. E. BIRCH, Harbison-Walker Refractories Co., Pittsburgh, Pa.
Past-President: A. F. GREAVES-WALKER, Univ. of North Carolina, Raleigh, N. C.

The election of the Institute of Ceramic Engineers to membership on the American Engineering Council was mentioned briefly in the July *Bulletin*. This is one of several engineering groups which has been on the scene for some time, promoting the professional activities of engineers and, in this particular instance, having a principal view to public relations.

The American Engineering Council was created almost twenty years ago to provide concerted action by engineers on social and economic questions. The preamble to the Council's constitution states that its object "shall be to further the public welfare wherever technical and engineering knowledge and experience are involved and to consider and act upon matters of common concern to the engineering and allied technical professions."

The particular way in which this function is being performed is perhaps best shown by listing some of the specific activities of the A.E.C. as follows:

(1) Early this year the Council held in Washington its third public forum for the discussion of questions which interest engineers and the public in general. The subjects discussed at Washington were (*a*) National Planning and the Engineers' Relation to It, (*b*) Economic Status of the Engineering and Kindred Professions, (*c*) Engineering Aspects of Government Reorganization, and (*d*) Engineering and Economic Factors in the Size of Business. The two previous forums discussed Employment and the Engineers' Relation to It and Invention and the Engineers' Relation to It. The minutes of these three forums (available for 25 cents each at the headquarters of the American Engineering Council, 744 Jackson Place, Washington, D. C.) are interesting and should be studied by every engineer.

(2) Upon request, the Council transmits engineering opinion and factual information to legislative and administrative branches of the Federal Government. It also interprets for the engineering profession the import of Federal laws, rules, regulations, and practices. Because of the major importance of these two services, the American Engineering Council has its headquarters in Washington, D. C.

(3) The dissemination of information to its member societies is accomplished by the *A.E.C. Bulletin*, issued monthly, and by separate reports of various kinds. These special reports and studies have covered many separate subjects judged by a few titles as follows: "Waste in Industry," "Safety and Production," "Patent Office," "Civil Aviation," and "National Census of Engineers."

(4) The important public affairs committee of the A.E.C. is encouraging the establishment of state and local public affairs committees so that coördinated action by the engineering profession may be obtained on matters of public concern.

These various functions of the A.E.C. are such as could not be handled by any one of the engineering societies working alone. The admission of the Institute of Ceramic Engineers to the Council brings its total membership to fifty-four as follows: 8 national, 18 state, and 28 local engineering societies. The A.E.C. is wholly financed by voluntary contributions from member societies.

The Executive Secretary of the A.E.C. is Frederick M. Feiker; officers for 1939 include *President*, William McClellan, President, Potomac Electric Power Co., Washington, D. C.; and *Vice-Presidents*, Carroll T. Bickelhaupt, American T. & T. Co., New York, N. Y.; Ralph E. Flanders, Jones-Lamson Machine Co., Springfield, Vt.; John S. Dodds, Iowa State College, Ames, Iowa; and Alonzo J. Hammond, 120 S. LaSalle Street, Chicago, Ill.

New Institute Members

Member

Joseph Early, 407 Peoples East End Bldg., Pittsburgh, Pa.
R. F. Geller, 306 West Thornapple St., Chevy Chase, Md.
M. E. Holmes, Dean, New York State College of Ceramics, Alfred, N. Y.
R. K. Hursh, University of Illinois, Urbana, Ill.
R. B. Keplinger, Metropolitan Paving Brick Co., Canton, Ohio
R. B. Ladoo, R. B. Ladoo Co., 224 Calvary St., Waltham, Mass.
Lane Mitchell, Georgia School of Technology, Atlanta, Ga.
H. Z. Schofield, Eng. Expt. Sta., Ohio State Univ., Columbus, Ohio
M. H. Waldschmidt, National Tile Co., Anderson, Ind.

Associate Member

A. J. Blume, Square D Co., Peru, Ind.
E. C. Clemens, Cannelton Sewer Pipe Co., Cannelton, Ind.
W. G. Collins, Johns-Manville Co., Waukegan, Ill.
C. G. Fels, Atlantic Terra Cotta Co., Perth Amboy, N. J.
H. D. Frankel, Jr., Laclede-Christy Clay Products Co., 823 K. of P. Bldg., Indianapolis, Ind.
C. L. Frederick, Jr., Plibrico Jointless Firebrick Co., 1800 Kingsbury St., Chicago, Ill.
J. G. Gill, United States Gypsum Co., 1253 Diversey Parkway, Chicago, Ill.
R. G. Hardy, Ludowici-Celadon Co., Coffeyville, Kans.
W. W. Kriegel, Montana School of Mines, Butte, Mont.
G. E. Milliken, Milliken Brick Co., Wilkinsburg, Pa.
J. P. Mulroy, 965 Lafayette Ave., Buffalo, N. Y.
J. A. Pask, University of Illinois, Urbana, Ill.
V. J. Roehm, Limoges China Co., Sebring, Ohio
R. F. Sherwood, United Feldspar Corp., New York, N. Y.
H. A. Smith, General Ceramics Co., Metuchen, N. J.

Junior Member

J. J. Amero, N. C. State College, Raleigh, N. C.
J. F. Day, Cronin China Co., Minerva, Ohio
N. L. Haldy, Ohio State University, Columbus, Ohio
C. M. Lampman, Jr., N. Y. State Ceramic Expt. Sta., Alfred, N. Y.
Addison Maupin, General Refractories Co., West Decatur, Pa.
J. A. Sarandria, Electro Refractories and Alloys Corp., Lackawanna, N. Y.
H. J. Smaltz, Ludowici-Celadon Co., New Lexington, Ohio
E. B. Synder, 1852 Korbel Ave., Columbus, Ohio
C. B. Tauber, Ohio State Univ., Columbus, Ohio

REPORT OF THE COMMITTEE ON MEMBERSHIP AND EXAMINATIONS

The commission of this Committee is to assemble and investigate the applications for membership, to operate a system of examination where called for, and to deliver the application with its recommendations to the Executive Committee, which has the final power to accept or reject candidates.

(1) Our Committee considered first the Rules for Membership and finds that only a limited number of states provide other than General Engineers' Licenses, and such a license does not justify recognition as a Ceramic

Engineer. We, therefore, proposed to the Executive Committee that the candidate be requested to submit evidence to prove his qualifications as a ceramic engineer in the absence of a state-issued Ceramic Engineer's License, and that such evidence, if confirmed, be substituted for the examination. This was refused on the grounds that an examination is called for in the Rules of the Institute. Our Committee believes that any examination given must be properly supervised, and we can not approve examinations of different types for different classes of candidates.

(2) We are convinced that this Committee can determine the qualifications of candidates by reference to persons with whom they have been associated in ceramic service, and through a systematic questionnaire can assemble facts on which to base a more reliable report and recommendation than is possible by any form of examination not supervised by a disinterested person. This Committee has handled nearly 150 applications and has found only about five that would indicate the need of a specific examination. In such cases, it seems entirely feasible to insist that the candidate qualify as a General Engineer under his State License Board and that his ceramic qualifications be determined by the questionnaire system proposed.

(3) Our Committee recognizes the injustice of accepting a diploma from a ceramic engineering department which has recently qualified under E.C.P.D. when the education on which the diploma was granted may not meet such requirements. It also recognizes the injustice of refusing a diploma from a school which has not been accredited by E.C.P.D. in cases where the applicant can prove that he has fulfilled the requirements of a Ceramic Engineer for a period of years after graduation. It appears that the Executive Committee should make a ruling on the number of years of actual ceramic engineering experience which will be necessary in the case of graduates of nonaccredited ceramic engineering departments to meet the deficiences of their school education.

(4) This Committee has always based its recommendations upon the agreement of at least four of the five members, and many applications have been reviewed several times with added information each time before an agreement could be reached. In the future, it probably will be necessary to employ a stenographer by the hour to carry on the correspondence required. The time required for committee and other correspondence makes the handling of applications somewhat slow, but this can not be avoided. The applicant's record of education and industrial experience must be confirmed and the license should be checked. Such requests for information, however, frequently do not bring prompt replies.

(5) The ruling of the Executive Committee that applications which are regular and involve no question of validity shall be endorsed by the Chairman and sent directly to the Executive Committee has been respected, although as Chairman I am convinced that every application should be reviewed by the Membership Committee, inasmuch as this Committee is continuous, whereas the personnel of the Executive Committee changes each year. To keep the Membership Committee records complete, it is also necessary to abstract the records of each candidate. The work of sending copies to the members of the Committee does not involve much time or expense and the delay is negligible because the abstract can be circulated while the records are being confirmed.

(6) The work involved in this Committee is handled periodically and not daily as the applications are received. Form questionnaires covering the essential information needed from the schools and the references are now being prepared and will be submitted to the Executive Committee for approval if agreeable to the Membership Committee.

As Chairman of this Committee, I have no fear that an unworthy member will be admitted under the present system, but I am not certain that an examination by correspondence would not open the doors to persons who would not be admitted under the present system.

—Arthur S. Watts, *Chairman*

REPORT OF PERMANENT COMMITTEE ON SIMPLIFICATION OF VARIETY AND SIZES OF VITRIFIED PAVING BRICK

The Permanent Committee, meeting in the Department of Commerce Building, Washington, D. C., to accomplish the eighteenth annual review of Simplified Practice Recommendation R1, Vitrified Paving Brick, was held April 28, 1939.

Upon motion by Colonel Beightler, seconded by P. H. Bates, it was unanimously voted that the 4- by $3^1/_2$- by $8^1/_2$-inch wire-cut lug brick be not reinstated in the simplified list of recognized varieties of vitrified paving brick because its use is strictly localized in the City of Cleveland, Ohio, and vicinity.

Further, upon motion by Mr. Schlesinger, seconded by Colonel Beightler, it was unanimously voted that Simplified Practice Recommendation R1-36, Vitrified Paving Brick, be reaffirmed.

—C. C. Blair

CHANGES IN CERAMIC ENGINEERING CURRICULA DURING 1938–1939

Report of the Ceramic Educational Council Curricula Committee

The courses of study included in ceramic engineering curricula in American ceramic schools for the year 1937–1938 were published in the March *Bulletin*, 1938, pp. 135–40. The percentage of the entire curriculum devoted to each course and an average curriculum, representing the consensus of opinion of ceramic educators as to what courses and how much of each should be included in a ceramic engineering curriculum, were given in detail.

This report gives data on changes made in these curricula during the academic year 1938–1939. The data for each school were determined and reported to the writer by the heads of the various ceramic schools and therefore bear the approval of the schools concerned.

It is evident at the present time that American ceramic schools are not making any rapid or revolutionary changes in the courses of study included in their ceramic engineering curricula or the percentage of the entire curricula devoted to each of these courses. Except for details or minor items, ceramic educators are in surprisingly close agreement as to what ceramic engineers should be taught, and nothing now on the horizon indicates any important trend from the present established educational policy in this respect as presented in the average curriculum of the preceding report.

During the academic year just closed, four American ceramic schools made no curricular change. Of the remaining six from which data were obtained, four made changes so minor in character that they could not indicate any change in educational policy. Of the remaining two schools, one materially increased emphasis on physical chemistry and ceramic design at the expense of ceramic specialization; the other institution materially changed its educational policy as indicated by the greatly increased emphasis on mechanics, drawing, petrography, ceramic fundamentals, and ceramic design at the expense of foreign language, metallurgy, ceramic research, and mechanical engineering. It is important to note, however, that these rather substantial changes are not leading a trend from generally approved practice, but the changes in this case brought this particular institution more in line with the others from which it alone had differed materially before these changes were made.

The average curriculm published in the March *Bulletin*, 1937, p. 113, still stands as the concensus of opinion of ceramic educators and seems still to be the standard toward which the curricula of all ceramic schools are gravitating.

—M. E. Holmes, *Chairman;* A. F. Greaves-Walker, N. W. Taylor, and F. H. Norton, *Committee on Ceramic Engineering Curricula*

Changes During 1938–1939 in Ceramic Engineering Curricula

Note: The figures indicate the percentage of the entire course devoted to the various items; the figures in parentheses indicate the amount of the subject given in other courses. Institutions numbered I, II, III, and VI reported no change; No. VII did not submit data.

Curriculum	IV (1937–38)	IV (1938–39)	V (1937–38)	V (1938–39)	VIII (1937–38)	VIII (1938–39)	IX (1937–38)	IX (1938–39)	X (1937–38)	X (1938–39)	XI (1937–38)	XI (1938–39)
(1) Mathematics												
(*a*) Algebra	3.33	3.33	2.46	2.50	0.0	0.0	2.65	2.6	2.2	2.2	1.13	.84
(*b*) Trigonometry	1.67	1.67	2.46	2.50	2.6	2.9	2.65	2.6	2.2	2.2	2.25	2.54
(*c*) Analytical geometry	1.67	1.67	2.46	2.50	2.6	2.9	2.65	2.6	2.2	2.2	3.38	3.38
(*d*) Differential calculus	2.67	2.67	1.64	1.75	2	2.1	1.99	2.0	1.7	1.7	3.38	3.38
(*e*) Integral calculus	2.67	2.67	3.27	3.50	2	2.1	1.99	2.0	1.7	1.7	3.38	3.38
Total	12.00	12.00	12.29	12.75	9.2	10.0	11.93	11.8	10.0	10.0	13.52	13.52
(2) Chemistry												
(*a*) General	6.67	6.67	4.90	5.00	5	4.9	5.75	5.7	6.6	6.6	5.41	5.41
(*b*) Analytical	7.33	7.33	3.27	3.50	4.7	5.6	2.65	2.6	1.7	1.7	5.41	5.41
(*c*) Physical	6.00	6.00	2.05(+2.23)	3.00(+2.50)	3(+2)	3.6	2.65	2.6	3.3(+1.7)	5.0	4.06	4.06(+1.00)
(*d*) Organic											0.00	0.00
(*e*) Metallurgical												
Total	20.00	18.67	10.22	11.50	12.7	14.1	11.05	10.9	11.7	13.3	14.48	14.88
(3) Physics												
(*a*) Mechanics	2.00	2.00	1.64	1.75	2	1.4	2.21	2.3	2.2	2.2	2.54	2.80
(*b*) Sound	1.00	1.00	0.22	0.25	1	1.3	0.88	0.9	0.6	0.6	0.51	0.76
(*c*) Heat	2.00	2.00	1.41(+0.50)	1.5(+0.05)	1.5	1.4	2.21(+2)	0.7	1.1	1.1	1.53	1.28
(*d*) Electricity, magnetism	2.00	2.00	1.08	1.00	1	1.4	0.88	2.3	2.8	2.8	2.29	2.03
(*e*) Light	1.00	1.00	0.55	0.50	1	1.4	0.88	0.7	1.7	1.7	1.27	1.28(+0.68)
Total	8.00	8.00	4.90	5.00	6.5	6.9	7.06	6.9	8.4	8.4	8.14	8.15
(4) English												
(*a*) Rhetoric and composition	4.00	6.00	3.69	3.75	3	3.6	3.98	4.0	0.0	0.0	4.07	4.06
(*b*) Literature	4.00	2.00	1.23	1.25			2.65	2.6	0.0	0.0	4.07	4.06
(*c*) Professional English	0.00	0.00	3.69	3.75	2	2.1	2.65	2.6	1.7(+1.1)	1.7(+1.1)	0.00	0.00
Total	8.00	8.00	6.61	8.75	5	5.7	9.28	9.2	1.7	1.7	8.14	8.12
(5) Geology	2.67	2.67	1.23	1.25	4	3.1	2.65	2.6	2.8(+1.1)	2.8(+1.1)	2.72	2.70(+1.00)
(6) Mineralogy	1.33(+0.67)	1.33+(0.67)	1.23(+1.00)	1.25(+1.00)	3	2.2	2.65	1.8	2.8	2.8	1.36	1.35(+1.00)
(*a*) Thermochemical mineralogy			1.23	1.00				0(+0.4)				
(*b*) Crystallography								0.9				
								2.7				
(7) Mechanics	4.00	4.00	3.69	5.00	4	5.6	5.31	5.3	6.6	6.6	4.73	4.73
(8) Mechanical engineering			2.05	2.00	1.5	0.0	6.2	1.2	1.7(+1.7)	1.7(+1.7)		3.38
(*a*) Power plants, steam	5.33	5.33						1.3			2.03	
								2.5			1.35	
(9) Electrical engineering	3.33	3.33	2.46	2.50	2.5	4.2	1.77	1.8	0.0	0	0.00	0.00
(10) Drawing	4.00	4.00(+2.67)	5.33	5.25	1.5	2.8	3.54	3.5	5.0(+0.6)	5.0(+0.6)	2.72	2.70(+1.00)
(11) Fuels and combustion			1.23(+1.00)	1.25(+1.00)	3	3.6	0.44(+2.5)	0.0	2.2(+0.6)	2.2(+0.6)	0.00	0.00(+1.00)
(*a*) Principles of metallurgy	2.00(+1.3)	2.00(+1.3)						1.3				
(12) Petrography	5.33		3.70	3.75	2	3.6	1.33	1.3	1.7	1.7		
(*a*) Optical mineralogy											0.00	0.00(+1.00)
(13) Pyrometry	0.67	0.67	0.41(+0.25)	0.5(+0.25)			0.44(+0.5)	0.4	0.0(+0.6)	0.0(+0.6)	1.36	1.35
(14) Ceramics												
(*a*) Fundamentals	8.67	10.67	11.00	8.50	9	11.1	8.41	11.1(+1.3)	11.7	11.7	1 18.40	19.60
(*b*) Specialization	6.66	6.00	4.69	6.00	8	7.6	4.42	4.0(+0.9)	8.8	5.8	2 3.38	3.30
(*c*) Research	2.00	2.00	2.46	1.25	3	0.7	2.21	1.8(+1.3)	4.5	4.5	3 3.25	2.03
(*d*) Design	4.67	4.67	4.10	4.25	2	3.5	1.33	2.2	0.0	3.0	1.36	1.35
Total	22.00	23.33	23.15	20.00	22	22.9	16.37	19.1	25.1	25.1	26.39	26.33
(15) Surveying	2.67	1.33	1.23	1.25	3	2.8	0.88	0.9	1.7	1.7	0.00	0.00
(16) Foreign languages			Elective		4	0.0	0.00	0.0	0.0	0.0	4 4.07	4.06 (opt.)
(17) Economics	4.00	4.00	6.15	5.00	0.0	0.0	5.31	5.3	1.7	1.7	5 4.07	4.06 (opt.)
(18) Electives			7.38	7.25	6.5	10.5	13.27	10.5	8.3	9.5	0.00	0.00
(19) Miscellaneous		1.33	4.69	4.50	6.5	2.0	0.44	4.0		3.3	4.75	4.73
(*a*) Mining and metallurgy					3.2		0.0		8.8	9.5	0.00	0.00
Grand Total	105.33	100.00	100.28	100.0	100.0	100.0	99.92	100	100.0		99.73	100.3
Required for graduation	150 credit hr.		244 term credits		155 credit hr.		222 quarter hr. credit		180 quarter hr. credit		148 credit hr.	

REPORT OF STRUCTURAL CLAY PRODUCTS RESEARCH FOUNDATION

To A. I. Andrews, *President*, June 6, 1939
The American Ceramic Society

Organization Dissolved

At the annual meeting of the Board of Trustees of the Structural Clay Products Research Foundation, held at the Hotel Stevens, Chicago, on April 18, 1939, during the Annual Meeting of The American Ceramic Society, the resolution adopted by the Board of Trustees of The American Ceramic Society on January 11, 1939, requesting that the Foundation be dissolved, was considered.

The Board of Trustees of the Foundation voted to comply with this request, and the President and Secretary were instructed to notify the Secretary of the State of Ohio to cancel the Articles of Incorporation which were issued by him to the National Brick Manufacturers' Research Foundation. The Secretary of the State of Ohio has been so notified, and this Foundation has been duly dissolved.

Organized in 1931

The National Brick Manufacturers' Research Foundation was formed in February, 1931, at Cleveland, Ohio, during the Annual Meeting of The American Ceramic Society, and was the result of the consolidation of the National Brick Manufacturers' Association with the Heavy Clay Products Division of The American Ceramic Society. The members of these two organizations were transferred to the new Structural Clay Products Division of The American Ceramic Society, which was formed from the two old organizations. The research program and organization was transferred to the National Brick Manufacturers' Research Foundation, which was formed at that time and which was incorporated, not for profit, under the laws of Ohio on July 16, 1931. General Edward Orton, Jr., was President of The Society at that time and was the leader in promoting this consolidation.

Research Committees

This Foundation carried on and extended the Research Program started by the National Brick Manufacturers' Association. It has promoted and directed research in the production, properties, and uses of structural clay products through the work of seventeen research committees as follows:

(1) *Research Committee: Chairman*, C. W. PARMELEE, Univ. of Illinois, Urbana, Ill.; *Secretary*, D. F. STEVENS, Danville, Ill.; H. C. KLEYMEYER, Standard Brick & Tile Corp., Evansville, Ind.; EBEN RODGERS, Alton Brick Co., Alton, Ill.; and C. F. TEFFT, Claycraft Co., Columbus, Ohio.

(2) *Nomenclature and Material Classification:* P. E. Cox, Iowa State College, Ames, Iowa (now New Orleans, La.).

(3) *Clay Winning:* A. V. HENRY, Georgia School of Technology, Atlanta, Ga. (deceased).

(4) *Transportation and Storage of Raw Materials:* T. N. MCVAY, Univ. of Alabama, University, Ala.

(5) *Preparation of Raw Materials:* A. S. WATTS, Ohio State Univ., Columbus, Ohio.

(6) *Pugging and Machining; Stiff-Mud Process:* G. A. BOLE, Ohio State Univ., Columbus, Ohio.

(7) *Pugging and Machining; Soft-Mud Process:* G. H. BROWN, Rutgers Univ., New Brunswick, N. J.

(8) *Dry-Press Process:* M. E. HOLMES, N. Y. State College of Ceramics, Alfred, N. Y.

(9) *Drying and Drier Design:* R. K. HURSH, Univ. of Illinois, Urbana, Ill.

(10) *Burning and Kiln Design; Updraft and Scove Kilns:* G. J. BARKER, Univ. of Wisconsin, Madison, Wis.

(11) *Burning and Kiln Design; Periodic Kilns:* A. F. GREAVES-WALKER, Univ. of North Carolina, Raleigh, N. C.

(12) *Burning and Kiln Design; Continuous Kilns:* T. A. KLINEFELTER, Bureau of Standards, Columbus, Ohio (now Washington, D. C.).

(13) *Power Generation and Application:* J. D. MARTIN, Moulding-Brownell Corp., New Straitsville, Ohio.

(14) *Storage and Transportation of Finished Products:* J. OATIS WILCOX, Alliance Clay Product Co., Alliance, Ohio.

(15) *Clay Plant Economies:* T. W. GARVE, Consulting Engineer, Columbus, Ohio.

(16) *General Data:* A. I. ANDREWS, Univ. of Illinois, Urbana, Ill.

(17) *Comm. on Reinforced Brick Masonry:* HUGO FILIPPI, Illinois Brick Co., Chicago, Ill.

The investigations of these Research Committees have been published in twenty-three bulletins as follows:

Bulletin No.	Title
101	Broadened Scope of Research Work
102	Drying and Drier Design
103	Research Program
104	Drying and Drier Design, Drier Tests
105	Sulphur Gases and Drier Scumming
106	Relative Humidity and Moisture Content of Air
107	Brick Plant Power Tests
108	Research Program
109	Investigations of Dry-Press Process
110	New Method of Loading Face Brick
111	Better Transportation and Storage of Clays
112	Progress in Clay Winning
113	Advances in Downdraft Kiln Design and Operation
114	Tests of Direct-Heat Driers of the Chicago Brick Company
115	Portable Automatic Stoker for Tunnel Kilns
1	Organization, Purposes, and Plans of the National Brick Manufacturers' Research Foundation
2	Report of Comm. on Reinforced Brick Masonry
3	Method of Testing Reinforced Brick Masonry; Demonstration Structure
4	Results of Tests on Ten Demonstration Structures with Summary Covering Tests on Thirteen Structures
5	Reinforced Brick Masonry; History, Summary of Tests, Structures Erected, and Bibliography to Date
6	Preliminary Outline of Program of Research in Reinforced Brick Masonry
7	Tentative Specifications for Reinforced Brick Masonry
8	Results of Tests on Seven Demonstration Structures with Summary Covering Tests on Twenty Structures

Name Changed in 1935

The name of the Foundation was changed in February, 1935, at Buffalo, N. Y., to the Structural Clay Products Research Foundation. This and other changes in the By-Laws of the Foundation were approved by the Board of Trustees of The American Ceramic Society on June 7, 1935. The Foundation has always been affiliated with The American Ceramic Society. Since 1935, this has been effected through the Chairmen of the Structural Clay Products, Terra Cotta, and Materials and Equipment Divisions, who were ex-officio members of the Board of Trustees of the Foundation.

Accomplishments

During the past three years, the extreme curtailment of the structural clay products industry has made it impossible for the Foundation to finance any active research. We feel that the various research projects that were carried out by this Foundation during its life, notably those in reinforced brick masonry, drying, and other phases of production of structural clay products, have made a worthy contribution to our industry.

On behalf of our Board of Trustees, I wish to express our appreciation of the coöperation of The American Ceramic Society in the work of the Foundation, and of the distinguished service given so generously by C. W. Parmelee, who has directed our research program, and by you and the other chairmen of our various research committees who have carried it on.—D. F. STEVENS, *Former Secretary*

NECROLOGY

JAMES E. LEWIS

James E. Lewis, aged sixty-six years, chairman of the board of directors of the Harbison-Walker Refractories Co., Pittsburgh, Pa., died on May 25, 1939, after an illness of several months. He entered the Harbison-Walker plant in Woodland, Pa., in 1886 and advanced steadily until he was elected president in 1920. On December 3, 1936, he completed fifty years of continuous service with the organization, having been foreman, superintendent, assistant to the vice-president, general manager, president, and chairman of the board of directors.

In 1902, Mr. Lewis was head of the Hays works of the Woodland Firebrick Co., which subsequently became affiliated with Harbison-Walker. He became general superintendent and then assistant to the vice-president in charge of all works. In 1913, he was appointed vice-president and manager and in 1920 was named president.

Mr. Lewis was also a director of the American Refractories Institute. He did more than any one other individual to place the refractories industry on an ethical basis.

J. E. Lewis

W. T. CHRISTIAN

W. T. Christian, superintendent of the Ironton Fire Brick Company, Ironton, Ohio, died on June 16, 1939. Mr. Christian was identified with the firebrick industry during his entire lifetime, having been connected with the Olive Hill Fire Brick Company, Harbison-Walker Refractories Company, Olive Hill, Ky., Wellsville Fire Brick Company, Wellsville, Mo., and with the Ironton Fire Brick Company since 1927.

He had been a member of The American Ceramic Society since 1935.

DONALD S. ALBRIGHT

A heart attack caused the sudden death on June 16, 1939, of Donald Sebring Albright at the age of forty-three in Sebring, Ohio. Death was attributed to coronary thrombosis. The source of the attack, it was believed, may have been associated with a streptococcic infection.

Mr. Albright was president and general manager of the Limoges China Company, vice-president of the Sebring Pottery Company, and vice-president of the Salem China Company. He was also in charge of sales for all three companies and was the oldest member in point of service of the office and executive staff at the Limoges plant.

A native of East Liverpool, where he was born April 13, 1896, he came to Sebring with his parents when the town was started. His father was Charles J. Albright, general manager of Limoges, and his mother was the former Emma Sebring, sister of the Sebring brothers who founded the town.

Entering Ohio State University for study in the College of Ceramics, he left school after two years and joined the U. S. Army. He served in the officers' training school at Camp Meade, Md., and Camp Gordon, Atlanta, Ga. While at Atlanta he was commissioned as a second lieutenant in the infantry.

At the close of the war, he joined the Limoges force to take charge of three tunnel kilns, the first kiln of this type in the United States.

He became assistant general manager of Limoges and was named general manager in 1924, holding that position up to the present time. In February, 1937, he was elected president and general manager.

Mr. Albright was closely associated with F. A. Sebring, Limoges head, until the latter's death two and one-half years ago. He was particularly valuable to the plants he served for his sales ability. At the time of his death he was in the midst of preparations for the summer pottery show to be held in New York.

G. W. CRUMBAKER

G. W. Crumbaker, secretary and member of the Board of Directors of the Abingdon Sanitary Mfg. Co., Abingdon, Ill., died on June 10, 1939. Mr. Crumbaker had been associated with this Company since 1917.

NEW YORK STATE COLLEGE OF CERAMICS

The Student Branch of the New York State College of Ceramics has concluded another successful year. Meetings were held each month with an average attendance of approximately 120.

The speakers and their subjects were as follows: Clair V. Mann, "Adaptability of Students to Engineering Education"; Emerson P. Poste, "Enamels"; W. A. Rudisill, "Silk Screen Process for Milk Bottles"; P. H. Bates, "Hydraulic Cements"; and R. E. Gould, "Manufacture of High-Fire Porcelain Dinnerware."

Interest in these meetings has steadily mounted during recent years. All students in the Technology and Engineering Departments of the College are members, a total membership of approximately 220.

The officers of the Society for the past year were as follows: *President*, Joseph A. Proe, Jr.; *Vice-President*, Lucius H. Washburn; *Secretary*, Martin E. Dykeman; and *Treasurer*, Julius W. Siegel.

The following officers were elected for 1939–40: Frank C. Arrance, *President*, a junior honor student and member of Keramos; Stephen Day, *Vice-President;* William Drohan, *Treasurer;* and Bernhard F. Gentsch, *Secretary*.

GEORGE W. MOREY

The Honorary Degree of Doctor of Science was presented to George W. Morey by Alfred University, Alfred, N. Y., in June, 1939. The July, 1939, *Bulletin*, pp. 257–58, carried the sketch of Dr. Morey's scientific achievements written by M. E. Holmes, Dean of the New York State College of Ceramics of Alfred University. To supplement this material, a life sketch of Dr. Morey is presented here.

George W. Morey was born January 9, 1888, in Minneapolis, Minn., son of George W. and Celia Morey. It is stated that the family name originally was Moreau, and the first ancestor of this family came to the United States from France with Lafayette.

George Morey was educated in the Minneapolis public schools and was graduated from the University of Minnesota with the degree of B.S. in chemical engineering in 1909. During his senior year, he was assistant to G. B. Frankfurter, Dean of the School of Chemistry.

In July, 1909, he went to the Bureau of Standards, Washington, D. C., where he worked on the preparation of calorimetric and acidimetric standards and on the liquefaction of gases.

George W. Morey, Doctor of Science, Alfred University

He joined the staff of the Geophysical Laboratory in February, 1912, where he has been ever since, except for a short leave of absence during the World War.

His work at the Geophysical Laboratory has dealt chiefly with the study of silicate systems containing water and also with the effect of water at high temperatures and pressures in geological processes. One result of these studies is an explanation of volcanism in the terms of physical chemistry, which has been successfully applied.

Other work of Dr. Morey has dealt with phase equilibria in anhydrous systems, with special reference to those systems of special importance in the hydrothermal work. These are primarily the systems containing sodium or potassium oxide, and this study has led directly into the field of commercial glass compositions and therefore into the field of glass.

His studies on glass began during the World War when, with other members of the Geophysical Laboratory staff, he was concerned with the manufacture of optical glass. Dr. Morey's first part in this problem involved the annealing of glass and, with F. E. Wright, he worked out an annealing schedule at the plant of the Bausch and Lomb Optical Company at Rochester, N. Y. Similar studies were carried on at the Pittsburgh Plate Glass Company at Charleroi, Pa., in association with colleagues from the Geophysical Laboratory.

Following this work at Charleroi, Dr. Morey went to the optical glass plant of the Spencer Lens Company at Hamburg, N. Y., where he was in charge under the War Industries Board until shortly after the Armistice. He then became manager of this plant and served in this capacity until May, 1920, when he returned to the Geophysical Laboratory.

Dr. Morey's publications include eighty-one published papers, ten book reviews, and two books. The papers range in subject from the composition of liquid air to the phase-equilibrium relationships in several silicate systems, the theory of such relationships, and the culture of orchids.

Of these contributions, Dr. Morey has stated that he is especially proud of his contribution, "The Phase Rule and Heterogeneous Equilibrium," in the Commentary on the Scientific Writings of Willard Gibbs, a book published by the Yale University Press. His books are The Properties of Glass, American Chemical Society Monograph Series, No. 77, published by the Reinhold Publishing Company in 1938; and The Electrical Properties of Glass, written with J. T. Littleton and published in 1933 by John Wiley & Sons, Inc.

Dr. Morey is a Fellow of the Society of Glass Technology in England and a member of The American Ceramic Society, American Chemical Society, American Optical Society, Washington Academy of Sciences, Washington Chemical Society, American Society for Testing Materials (chairman of the Committee of Glass and Glass Products), American Orchid Society, and Alpha Chi Sigma. During 1931–1932, he served as Chairman of the Glass Division of The American Ceramic Society.

MONTANA SCHOOL OF MINES

W. Wurth Kriegel of the Montana School of Mines has announced that Charles W. Dougan of Victoria, B. C., was awarded the degree of Master of Science in Ceramics at Commencement on June 2, 1939. The title of his thesis was "Study of the Dehydration and Rehydration of Some Clays." Mr. Dougan's undergraduate work was taken under T. N. McVay at the University of Alabama.

ALEXANDER SILVERMAN MOTION PICTURE FILMS

Alexander Silverman has contributed to The Society 1600 feet of 16-mm. motion-picture film of the International Ceramic Tour of 1928 which was sponsored by The Society. A second film which shows Dr. Silverman's unusual collection of rare glass has also been given to The Society. These films are available to groups of members who may wish to show them, and they may be secured for loan by writing to the General Secretary of The Society.

The Board of Trustees and the members of The American Ceramic Society wish to acknowledge with gratitude the gift of these motion-picture films.

G. H. MCINTYRE RECEIVES PH.D. DEGREE

Glenn H. McIntyre was born in San Francisco, Calif., on October 10, 1902. He was graduated from Santa Clara High School in June, 1920. The following fall he entered Leland Stanford Junior University at Leland Stanford, California, to study chemical engineering. He was elected to the Alpha Alpha Chapter of Alpha Chi Sigma in 1922. In the summer of 1923, he assisted a member of the staff of the American Smelting and Refining Company in the investigation of the concentrations of sulphur dioxide in air harmful to vegetation. He received the degree of Bachelor of Arts in Chemistry in the spring of 1924.

During his senior year he conducted a research on the vapor-tension curves of phosgene solutions of aluminum chloride at 0°C and 25°C. These data were published in the *Journal of Physical Chemistry* in 1925.

From May, 1924, until September, 1925, he was employed by Pike and West, chemical engineers of San Francisco, as an assistant on a hydrometallurgical research program for the Engle Copper Mining Co. The process was developed to successful pilot plant operation.

In September, 1925, he was awarded the Cushman Fellowship for fundamental research in porcelain enamels. This research was conducted from September, 1925, until June, 1928. He was awarded the degrees of Master of Arts in Chemistry in 1927 and of Ph.D. in Chemistry on June 14, 1939, at Western Reserve University.

He was employed as chief chemist for the Ferro Enameling Company in 1928 and became director of research in the laboratories for the Ferro Enamel Corporation upon the merger of the Ferro Enameling Company and the Ferro Enamel Supply Company in 1930. He has continued in this capacity.

He is a member of The American Ceramic Society, American Chemical Society, Sigma Xi, Cleveland Society of Professional Engineers, and is a registered engineer in chemistry and ceramics in the State of Ohio. He has held various offices in The American Ceramic Society, namely, Chairman of the Program Committee of the Enamel Division; Chairman of the Enamel Division and Councillor of the Enamel Division; Chairman of the Research Committee of The American Ceramic Society; and this year is a member of Nominating Committee A of The American Ceramic Society.

He has presented several papers before The American Ceramic Society and has contributed the following to the published literature:

(1) "Properties of Phosgene Solutions: Vapor-Tension Curves of Aluminum Chloride Solution at 0° and at 25° (with A. F. O. Germann), *Jour. Phys. Chem.*, **29**, 102–105 (1925).

(2) "Application of Gardner Mobilometer to Enamel Slip Consistency Studies and Controls" (with J. T. Irwin), *Jour. Amer. Ceram. Soc.*, **15** [8] 433–38 (1932).

(3) "Effect of Sodium Aluminate on Consistency and Acid Resistance of Some Acid-Resistant Enamels" (with J. T. Irwin, W. K. Carter, and R. M. King), *ibid.*, **16** [7] 315–18 (1933).

(4) "Reliability of Cross-Bend, Impact, and Reflectivity Data Obtained from Various Sizes of Test Pieces" (with J. T. Irwin, and M. G. Ammon), *ibid.*, **16** [7] 338–41 (1933).

(5) "Graphical Computation of Opacity of Porcelain Enamels," *ibid.*, **17** [10] 300–306 (1934).

(6) "Recent Enameling Clay Development," *Enamelist*, **12** (1934).

(7) "Effects of Water Vapor on Porcelain Enamel During Firing" (with H. E. Ebright), *Enamelist*, **10**, 11 (1933).

(8) "Study of Furnace Atmospheres and Temperature Gradients and Their Effect on Porcelain Enameling (with H. E. Ebright and J. T. Irwin), *Jour. Amer. Ceram. Soc.*, **18** [10] 297–302 (1935).

(9) "Effect of Neutralizing Solutions on Ground-Coat Draining (with P. E. Gerdes), *ibid.*, **19** [9] 253–56 (1936).

(10) "Enamel Stained by Combustion Gases of Enameling Furnaces," *Emaillerie*, **4**, 9–13 (1936).

(11) "Influence of Furnace Gases on Porcelain Enameling," *Enamelist*, **14** [4] 6–10 (1937).

(12) "Frit Solubility: I, Comparison of Methods of Determination and Relation of Soluble Salts to Enamel Slip Consistency" (with R. E. Bevis), *Jour. Amer. Ceram. Soc.*, **19** [9] 249–52 (1936).

(13) "Frit Solubility: II, Controlled Variables of Frit Composition and Their Relation to Enamel Consistency" (with R. E. Bevis), *ibid.*, **21** [5] 184–88 (1938).

(14) "Enameling of Hollow Ware" in Manual of Porcelain Enameling, Chapt. 12, pp. 200–48. Ed. by J. E. Hansen, Enamelist Publishing Co., Cleveland, Ohio, 1937.

(15) "Burning Furnace Atmosphere and Temperature Gradient," *ibid.*, Chapter 19, pp. 384–400.

(16) "Physical Testing of Hollow Ware," pp. 155–63 (1937). Proceedings First Annual Forum of the Porcelain Enamel Institute, Univ. of Illinois, Urbana, Ill.

(17) "Color Matching of White Parts," *ibid.*, pp. 163–87 (1938). Proceedings Third Annual Forum of the Porcelain Enamel Institute, Univ. of Illinois, Urbana, Ill.

(18) "Recent Developments in Sheet Enameling Practice," *Stove Builder*, **4**, 30–33 (1939); *Sheet Metals Industries*, **13**, 527–28 (1939).

G. H. McIntyre

Patents

(1) U. S. Pat. 1,869,019, "Method for Recovery of Fluorides from Enamel Glass Smelter Gases."

(2) U. S. Pat. 1,870,636, "Apparatus for Making Glass and Vitreous Enamels."

(3) U. S. Pat. 2,097,378 and 2,097,379. "Apparatus for Smelting" (with R. W. Stuart).

Other Publications

Mr. McIntyre is editor of *Technical Bulletins* by the Technical Staff of the Ferro Enamel Corp., Cleveland, Ohio.

(1) J. C. Bell, "Heat Transfer of Porcelain Enamel Metals and Other Materials," *Tech. Bull.*, No. 1, June, 1938.

(2) B. J. Sweo and M. J. Bahnsen, "Stabilization of the Reflectance and Color of Recoat Enamels," *ibid.*, No. 2, July, 1938.

M. J. Bahnsen, "Factors Affecting the Accuracy of Reflectance Determinations of Porcelain Enameled Surfaces," *Tech. Bull.*, No. 3, and B. J. Sweo, "Relation of Temperature Gradient to Tensile Failure in Porcelain Enamels," *ibid.*, No. 4 (to be released).

CERAMIC HISTORY

AMERICAN-MADE HAVILAND

Acclaim for perfect and exquisite products, no matter where or by whom they are made, is natural, but acclaim for products made by one's home people is given with pride. Americans are justly proud of the Havilands and of their accomplishments. They are Americans. This pride is more pronounced, however, because fine Haviland tableware is made not alone in France but also in America.

When one visits the Shenango Pottery in New Castle, Pa., he meets the genial James M. Smith and sees a plant "streamlined" and equipped throughout with the most modern devices. Here he sees exquisite china, equal to the world's finest, produced on "mass-production" scale and tempo. Here it is that Haviland in America is produced.

Not alone is this large plant modernized to an unusual extent, but the preparation of the raw materials is unusual Strict control of materials, processes, and product results in a high percentage of perfect ware, each piece of which has high strength, translucency, and brilliancy. The decorating of the ware, both underglaze and overglaze, is accomplished by Shenango methods, which insures a high percentage of perfectly decorated pieces.

It is not alone in the high quality of the product that one takes pride. The plant layout, the equipment, and the processes employed reflect human genius at its best. We take pride in the accomplishments of James M. Smith and his co-laborers.

AN AMERICAN IN FRANCE—THE STORY OF THEODORE HAVILAND*

Close to a century ago, a sailing vessel making its way from New York to Havre carried an American family—a young father and mother and their first-born—who reversed the westward tide of immigration by settling down in France. This family bore the now-famous name of Haviland, and the story of the china business which they founded is as romantic as any novelist could devise.

Not everyone is aware, perhaps, that Haviland is an American name and that it is due to American enterprise that this French china holds such a high position in the world of ceramics. In spite of the fact that three generations of the family have lived in France, they still maintain their American citizenship, and the Haviland men are educated in the United States. The founder of the business, who took his New England wife and their child on that momentous voyage back in 1839, was David Haviland. Up until that time he had been in partnership with his brother, Daniel G. Haviland, in the firm of D. G. and D. Haviland, importing English china, with headquarters in New York.

To the Haviland shop one day came a woman with a cup, a part of a tea service which she wanted to match. The fineness of the ware interested Mr. Haviland at once, and because of its quality and entire difference in type from the English china and earthenware he was importing, he believed it would be a good stroke of business to be the first to introduce it into America.

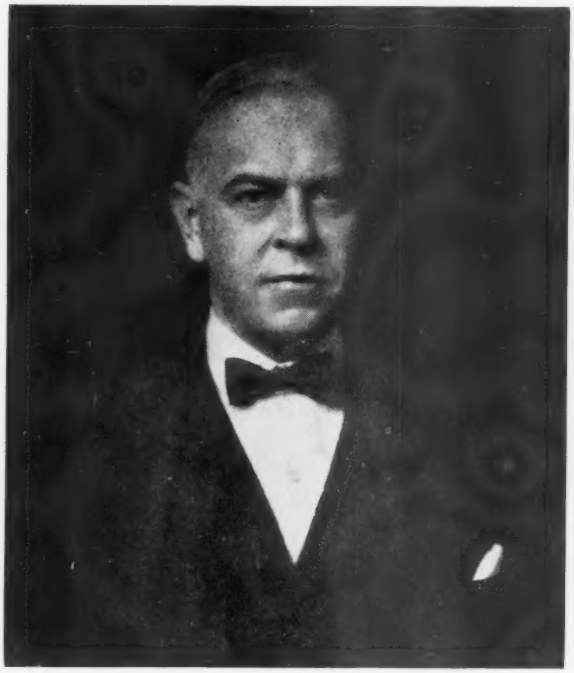
Mr. Haviland recognized the porcelain to be of French make, but it bore no distinguishing marks of any kind. He was sufficiently attracted by the ware, however, to cross the Atlantic and make a personal investigation of its source. This led him at last to Limoges, where china has been manufactured since 1768, the date of the discovery of kaolin in St. Yriex, a nearby town.

It was from Limoges, then, that Mr. Haviland began importing this fine porcelain. But he soon found difficulties in his path. The most outstanding of these was the wide divergence in taste and requirements between the French and the Americans—and it was his American trade, naturally, which Mr. Haviland must please.

The French manufacturers, whose factories were of limited capacity, were strongly disinclined to make the shapes and decorations to which they were unaccustomed but which Mr. Haviland knew were in demand in the United States. So he made his decision to move his family to France and to superintend the manufacture of china according to his own ideas.

The voyage to France, which was a matter of from two to five weeks in those days, ended at Havre, then by boat up the meandering Seine River, and by diligence across country, the Havilands finally arriving at Limoges, two hundred and forty miles southwest of Paris. There they established their home, and they settled down to what proved to be a life-time residence in the small French town. Three other children were born there, and Mrs. Haviland never again returned to the United States,

* Reprinted from *China, Glass & Lamps.*



William D. Haviland, son of Theodore Haviland, and present head of firm.

content to spend her entire life amid surroundings which had at first seemed strange and friendless.

When Mr. Haviland began to produce his own china in Limoges, the plain services which were suited to the American market were being made only in England. He started his new business, by making models of the types of services he wanted, and while these were being developed he was organizing and building decorating shops. In these shops, everything was added that would change the product from plain white to decorated ware of every style, from the simplest to the most elaborate.

The innovations begun in the new factory were not very well received among the French decorators. These artisans, accustomed to think of decoration solely in the terms of floral designs, even staged a mild revolt when they saw apprentices being instructed in many varieties of patterns. At first, in fact, both the apprentices and their teachers were compelled to go about only in groups, in order to protect themselves from attacks made by decorators who sought to save the old routine from change.

These difficulties were smoothed over in a short time, and the new Haviland factory began to produce china on a larger scale than had ever been attempted before in Limoges. New methods were introduced, machinery was employed in place of handwork exclusively, and it was not long before the business began to grow to large proportions.

The new Haviland and Company exported its first piece of Haviland china in 1840, and from the beginning the ware made a decided impression on the industry. Then shortly after 1890, Theodore Haviland, a son of David Haviland, built one of the largest and best-equipped factories in Limoges. In this factory, every modern device that was useful in making china was introduced—new machinery, new methods of decorating, and new methods of firing. Skillful French china makers were placed in charge of the manufacturing, and great ceramic artists were made heads of the decorating departments, and from this time on, the impetus given the industry was tremendous.

Entrance to factory at Limoges, France.

Inheriting his father's genius and enterprise, Theodore Haviland rapidly made his influence felt throughout the china world. Streams of artistic and novel decorations poured from the doors of his great factory and it was soon established as one of the leaders of its field. It has maintained this position through more than forty years, and the quality and beauty of its output is increasingly recognized.

Like his father before him, Theodore Haviland married an American woman and took her to Limoges to live, and both his son and his grandson have followed his example. Theodore Haviland died in 1919, and his son, William Haviland, took his place as head of the factory. The fourth generation of chinamaking Havilands is represented in the factory by Theodore Haviland, II, son of William Haviland.

One view of the Theodore Haviland factory is shown here. The picture was taken during an official visit of the Minister of Fine Arts of France to the factory and it gives an indication of the great size of the new buildings which were recently erected to take care of the constantly growing business.

Through its American offices at 26 West Twenty-Third Street, New York, the factory in Limoges is kept constantly aware of the trends in the market here and the types of designs which are considered most desirable on this side of the Atlantic. It has long since been found, of course, that the American public, on the whole, declines to accept the modernistic designs in china which are liked so much in France. Consequently, the majority of the popular patterns in Theodore Haviland china are modern treatments of the floral designs which have found most favor in these United States, particularly in full dinner services.

The high degree of vitrification of Haviland china is one of the reasons for its long-continued success, although the average housewife has little knowledge of such technicalities. She has found, nevertheless, that the patterns never fade or acquire that "washed-off" appearance and that even when it has been chipped, the china does not absorb grease and become discolored.

This is due to the fact that the entire china is completely vitrified. The "biscuit" is first fired at a low heat for hardening purposes, and then after it has been glazed it is fired again, this time at a tremendous heat which forces the glaze through and through the ware. It thus becomes thoroughly vitrified, with the same hardness of body under the glaze as the glaze itself. After it has been decorated, the ware is again placed in kilns and fired, and in this way the pattern is fused with the glaze and becomes indestructible.

This feature, however, is one that is more appreciated by the housewife after the passage of time than on the day of the purchase of the china. It is the beauty of the pattern that appeals to her, then, and the Theodore Haviland factory produces an extensive variety of designs. The American headquarters, alone, carries more than sixty patterns in open stock, and they range from the simplest rose motif to a modern conception, representing multicolored confetti bestrewing a white background with a tiny, confetti-covered tree as a center decoration.

COMMUNICATIONS AND NOTES FOR CERAMISTS

CLASSIFICATION OF CERAMIC DINNERWARE*

By Arthur S. Watts

This classification of dinnerware has been approved and submitted as a tentative standard by the Standards Committee of the White Wares Division, represented by *Chairman* J. H. Koenig, Hall China Co., East Liverpool, Ohio; E. K. Koos, Sterling China Co., East Liverpool, Ohio; and E. H. Lintz, Taylor, Smith, and Taylor Co., Chester, W. Va.

The following classification of ceramic dinnerware is offered in an effort to make the important differences clear and thus to enable the consumer to choose ware on the basis of properties rather than of surface appearance.

A complete classification must include three items, *viz.*, (*a*) the body, (*b*) the glaze, and (*c*) the decoration. Because the body and the glaze are fundamentally the most important and because all types of ware may be decorated by any of the various treatments, the matter of decoration will be reserved for later consideration.

Types of Dinnerware Body

The bodies of all ceramic dinnerware may be classified between two extremes, *viz.*, "porous bodies," which have the capacity of absorbing large amounts of water, and "vitreous bodies," which are absolutely impervious to water. Between these extremes, a wide variety of bodies is produced having various degrees of vitrification and translucency. As vitrification increases, the strength of the body and its resistance to chipping normally increases until a stage of glassiness occurs at which brittleness begins to develop. This property does not depend entirely on degree of vitrification, however, but is influenced also by composition. American china, for example, possesses an abnormal mechanical strength and resistance to chipping as well as a moderate-to-high translucency. An example of the opposite extreme is bone china, which, although rarely fired to complete vitrification, possesses extreme translucency as well as a definite brittleness and a tendency to chipping.

Lack of terminology limits an adequate classification,

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 18, 1939 (White Wares Division). Received June 22, 1939.

CLASSIFICATION OF DINNERWARE BODIES

	Name	Absorption (%)	Mechanical shock resistance	Translucency
(1)	Majolica	More than 15	Very low	None
(2)	Fine earthenware	10–15	Low; better than (1)	None
(3)	Semivitreous china	4–10	Medium to high	Little or none
(4)	Semivitreous porcelain	0.3–4	High	Low
(5)	Bone china	0.3–2	Medium	High
(6)	American hotel china	Less than 0.3	Very high	Medium
(7)	American household china	Less than 0.1	Very high	High
(8)	Belleek china	None	Medium to high	High
(9)	Porcelain	None	Medium to high	High

Relative translucency may be determined by holding articles of similar thickness an equal distance from a good light.
Absorption may be determined by boiling several small fragments of the ware for 2 hours in pure water, wiping to remove excess water, and determining the percentage increase in weight.

but for general considerations, the following data are offered, based on progressive vitrification and translucency.

Types of Dinnerware Glazes

The glazes employed on dinnerware may be classified between two extremes, *viz.*, (1) "a soft glaze" with an extremely brilliant, smooth surface but minimum resistance to scratching and (2) "a hard glaze" with moderate brilliancy and a wavy surface when examined under a microscope. This hard glaze will resist wear, but owing to its rougher surface texture, it tends to scratch. A smoother glaze, although slightly less resistant to wear, will frequently be less injured. Between these extremes, a wide variety of glazes is produced which possess various degrees of brilliancy and smoothness of surface to meet the demands of the various markets.

Classification of Dinnerware Glazes

(1) *Majolica:* soft, scratches readily with steel knife.
(2) *Fine earthenware:* medium soft, scratches moderately with steel knife.
(3) *Semivitreous china:* medium hard, scratches slightly with steel knife.
(4) *American china:* hard, does not scratch or scratches with extreme difficulty with steel knife.
(5) *Porcelain:* extra hard, does not scratch with steel knife.

Varieties of Dinnerware

Majolica has an extremely porous, opaque body covered with an opaque, white or colored, soft glaze. Typical examples are the majolicas of Italy and central Europe, the delftware of Holland, and some of the highly colored art tableware of the United States.

Fine earthenware has a porous, opaque body covered with a transparent, colorless soft glaze. Typical examples are queensware and earthenware of England, the white earthenware of continental Europe, and a limited production of white earthenware in the United States.

Semivitreous porcelain has the same body as semivitreous china, but it has a hard glaze of the porcelain type, applied to the unfired body. Body and glaze are matured in a single fire.

Semivitreous china has a semivitrified, white or ivory-colored body with very weak or no translucency, and it is covered with a medium-hard, transparent glaze. Typical examples are the so-called "semiporcelains" extensively manufactured throughout the United States.

American hotel china has a vitrified white or colored body of moderate translucency, and it is covered with a transparent hard glaze. It is manufactured only in the United States. This china is also produced in a double-thick ware in which the translucency is proportionately decreased.

American household china is similar to *American hotel china* in body and glaze, but it is produced in thin ware of similar translucency and weight to the porcelain dinnerware of Europe.

English china (*bone china*) has a commercially vitrified (0.3 to 2% absorption) body of pronounced translucency. It is covered with a transparent soft glaze of the fine earthenware type, which is not adapted for severe service. Bone china is not manufactured extensively except in England.

Belleek china has a vitrified, ivory body of pronounced translucency. It is covered with a transparent soft glaze of the fine earthenware type which is not adapted for severe service. A typical example is the Belleek china of Ireland. A dinnerware of similar type but possessing superior mechanical strength is manufactured in limited quantity in the United States.

Porcelain has a vitrified body of pronounced translucency. It is covered with a transparent, colorless, hard glaze which is matured with the body at a high temperature and possesses extreme resistance to abrasion. Porcelain originated in China and was reproduced in continental Europe, where it constitutes the only type of vitrified dinnerware extensively manufactured today. It is manufactured in limited amounts in the United States. Porcelain is also manufactured in Japan, but the body and glaze are matured at definitely lower temperatures, and most of it is mechanically inferior to the porcelains of China, continental Europe, and the United States.

Single-fire porcelain of zero absorption but of decreased translucency and covered with a transparent or a colored, opaque, hard glaze is also manufactured in special articles for table service in the United States.

DEPARTMENT OF CERAMIC ENGINEERING
OHIO STATE UNIVERSITY
COLUMBUS, OHIO

KYANITE IN EASTERN ALABAMA*

By Edgar Bowles

Kyanite in Alabama until recently has been known only from residual accumulations of float material, which usually occurs in large blocks apparently representing the erosion of veins of massive material. Such float material is known from Coosa, Tallapoosa, Clay, Randolph, Chilton, and Cleburne counties. Although this material contains extremely high-grade kyanite, the actual quantity available from such residual deposits is too slight to merit commercial exploitation. Intermittent efforts to discover the veins or pegmatites that yielded this material have been made, but until last year they met with no success.

Vein Source Discovered

Recent work on Turkey Heaven Mountain, southeast of Heflin in Cleburne County, has finally uncovered the vein source of some of the residual kyanite. Holes put down on the top of the ridge show a 2- to 4-foot vein of massive kyanite in characteristically long-bladed crystals.

The country rock cut by this kyanite vein is a mica schist included in the undifferentiated Talladega slate series or the Wedowee formation, generally acknowledged as pre-Cambrian. The trend of the schistosity parallels the regional trends of the rocks of the southern Piedmont Province, striking north-northeast and dipping rather strongly to the southeast. The strike of the kyanite vein parallels this schistosity. The vein largely consists of the massive kyanite, and blocks weighing up to two or three hundred pounds and consisting almost entirely of this one mineral have been removed from it. With the kyanite, however, is the typical mineral assemblage of such kyanite-rich pegmatites. Thin seams of graphite up to $\frac{1}{8}$ inch thick are present, and there is much muscovite and a few small stained garnets. Quartz seams penetrate the schist close to the kyanite vein and probably represent intrusions during the same period of igneous activity. This kyanite vein dips about 60 degrees where best exposed on the mountain top.

Continuity of Deposits

Some slight attempt has been made to prove the continuity of this kyanite deposit. A few shallow hand-dug trenches have cross-cut the strike of the vein, and it has been uncovered about 30 feet from the original hole; other trenches put down on the mountain top have been too shallow to yield positive evidence of the continuity of the vein. Although vein kyanite is usually irregular, this same vein, or others of a series of similar veins, extends for a distance of at least six miles. The vein has been uncovered a mile north of the original discovery and two to three miles south, and the float material is present as residual accumulations on the mountain top for at least four or five miles farther down the ridge. These vein discoveries in all cases follow a single trend and could represent a single irregular vein.

The softness and ease of erosion of the enclosing schist, compared with the relatively high resistivity of the massive vein, probably accounts at least in part for the topographic expression of Turkey Heaven ridge itself. Most of the small ridges of the vicinity are upheld by relatively thick quartz veins, and it is likely that this main ridge of the region has been protected likewise from erosional activity by the resistance of the kyanite vein.

Conclusion

Although at the present time kyanite mining in the Piedmont Province is confined entirely to kyanite schists and the placer deposits resulting from the weathering of such rocks, it is conceivable that successful exploitation of a sufficiently large vein of massive kyanite is possible. Further prospecting must be done to prove the continuity of the vein not only along the strike but down the dip.

Geological Survey of Alabama
University, Alabama

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 19, 1939 (Materials and Equipment Division). Received June 15, 1939.

ELECTRO REFRACTORIES AND ALLOYS SENIOR FELLOWSHIP CONTINUED

M. E. Holmes, Dean of the New York State College of Ceramics, has announced that the Senior Fellowship plan, inaugurated in 1938 by the Electro Refractories and Alloys Corporation of Buffalo, N. Y., will be continued for 1939–40. This plan extends a fellowship to a selected ceramic student during his senior year and permits thesis work under industrial direction. An advantage of this plan is the opportunity afforded the corporation of making a selection from a large number of candidates. This is not true of the usual graduate fellowships, because few ceramic students undertake graduate work. The senior plan permits consideration of the entire student personnel.

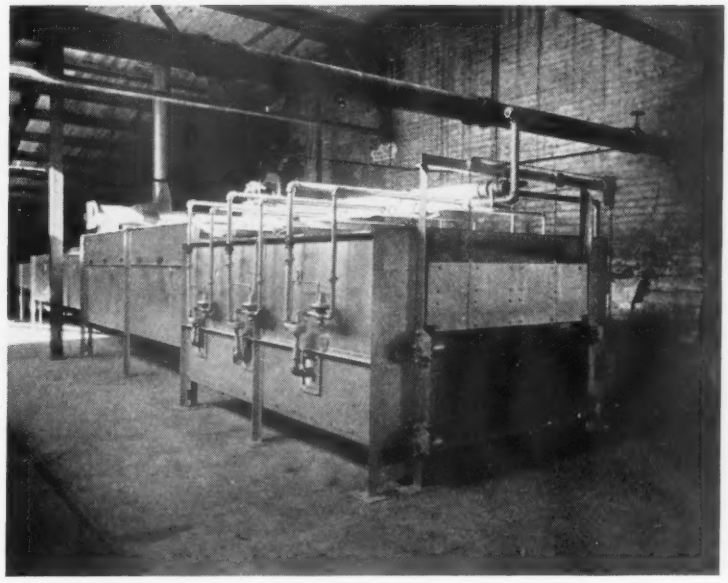
Last year, William Knapp, a senior student in the Department of General Ceramic Technology and Engineering, held this Fellowship and his thesis subject was "The Oxidation of Silicon Carbide." The results he obtained have convinced the management of the Electro Refractories and Alloys Corporation and also the school that the policy of granting scholarships to senior students is sound and should be continued.

The Fellowship for 1939–1940 has been awarded to Norman Kendall. Mr. Kendall was selected by L. U. Milward, President, and Grant S. Diamond, Vice-President of the Electro Refractories and Alloys Corporation. It is expected that his research accomplishments on this Fellowship will add materially to the first year's achievements in selling the idea to other ceramic corporations of establishing senior research fellowships. Dean Holmes believes the senior plan helps to develop an industrial viewpoint among students by securing actual contact with industry before graduation.

PORCELAIN ENAMEL INSTITUTE

The annual meeting of the P.E.I. will be held at the Pennsylvania Hotel in New York, N. Y., November 16 and 17, 1939.

The Fourth Annual Forum of the Institute will be held October 18 to 20 at the Deshler-Wallick Hotel, Columbus, Ohio.



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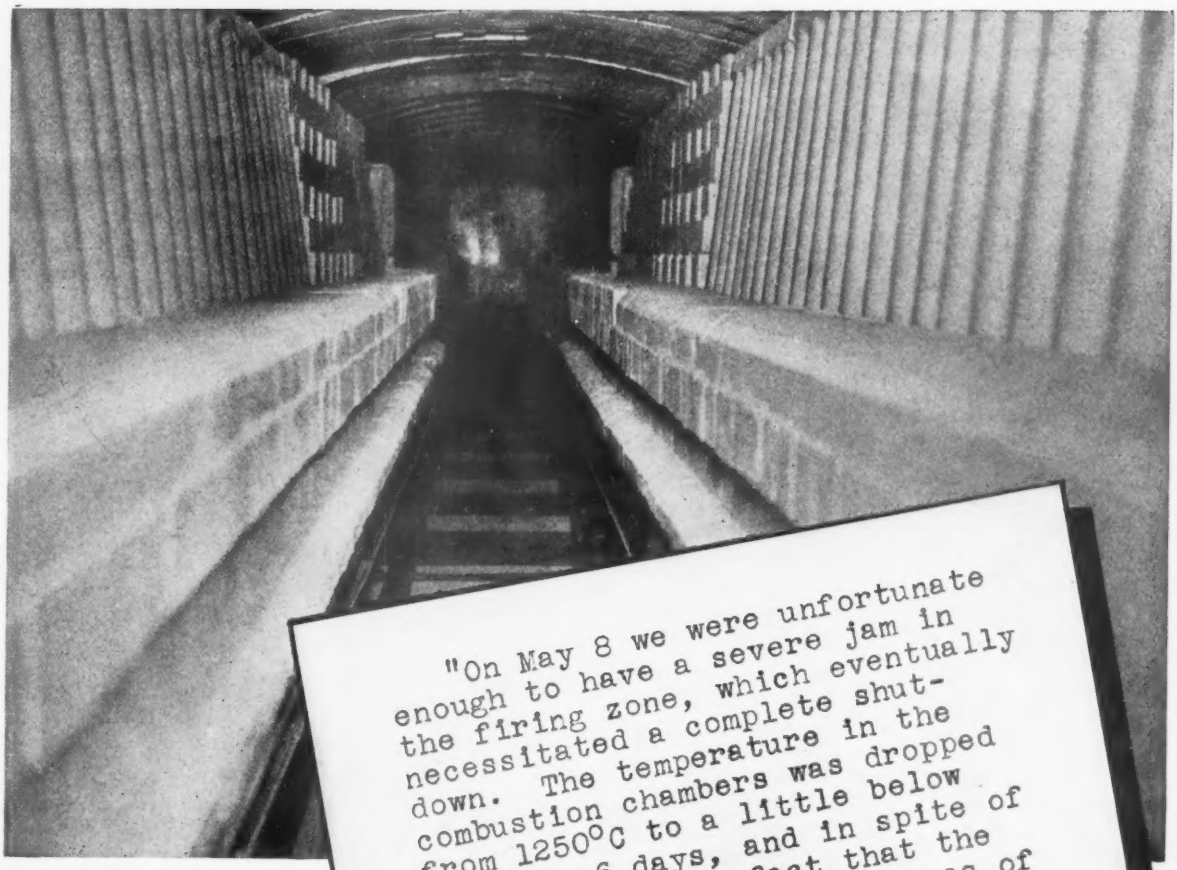

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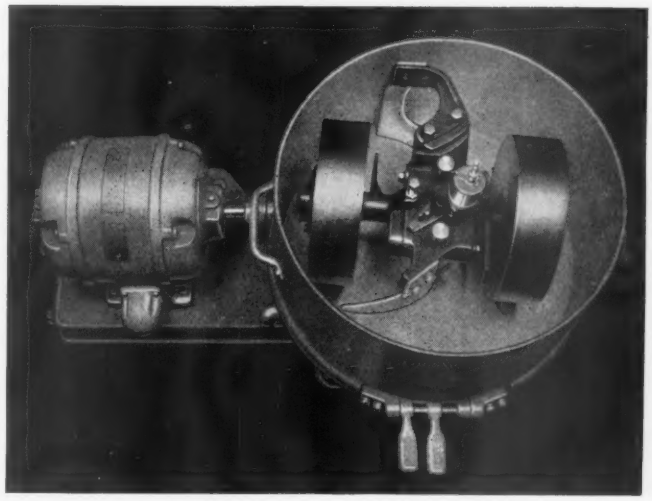

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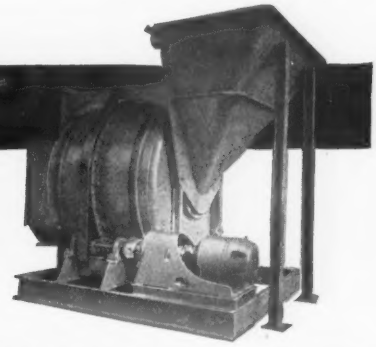

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